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Training Teachers of Junior College for Relational Thinking*

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THE art of thinking is not essential to living, but is extremely essential to human living. Reflective thinking, as distinguished from idle reverie, is relevant thinking. Relevant thinking is thinking in terms of the entities that are relevant factors of the problem or situation, the properties of these entities, that are relevant to the particular situation, and the relationships between these entities and their properties that bear upon the situation.

Reflective thinking presupposes certain general characteristics, which distinguish it from idle reverie. First, there is a recognition, on the basis of past experience and observation, that a certain entity has a certain characterizing property. Second there is an implied assertion that similar entities possess this characterizing property. Third, there is an induction, on the basis of such recognitions and observations, to a generalization that all such entities must possess the property under the discussion. Fourth, there is an identification of a specific relationship between the given entity and another entity which causes the former to have that property. Fifth, the induction is carried on to assert that a set of entities of the second class will cause the set of entities of the first class to possess that property. And sixth, the generalization is completed that the two classes of the entities are associated together by means of the particular relationship to produce the results observed as specific cases.

We may call this type of thinking, relational thinking, since it is thinking in terms of the relationship between the entities that constitute the situation or problem which is the subject of thinking. For the purposes of analysis of relational thinking, let us use the following notation:

x = an entity
C_x = a class of entities x_i ($i = 1, 2, \cdots, n$)
P = property possessed by an entity
R = relationship existing between two or more entities.

The analysis of relational thinking presents the following propositions:

Proposition I. *x has property P.* The recognition of the property P may by a result of direct observation, a recollection of similar observations in the past, or an acceptance of the observations of others. The proposition involves a definite relationship between the entity x and the property P, which characterizes the entity x. The entity x is one of the many mani-

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festations of the property P. The property P may be a qualitative property. For example, "this crow is black." However, mathematical analysis is not concerned with qualitative properties, unless they are measurable, that is, reducible to quantitative properties. The property P may be a quantitative property. Mathematical analysis is concerned with quantitative properties of whatsoever nature, provided they can be expressed in terms of known units.

Proposition I involves the recognition and formulation of the property P. For example, the statement, "5 is an integer," implies that being an integer is a property possessed by some numbers, and the formulation that number 5 is such a number.

Proposition I also implies the identification and classification of the entity x. The recognition of the property P is due to its being possessed by a class of entities. The entity x is identified on the basis of its possessing this property, and is classified with other entities possessing this property. For example, the statement, "triangle ABC is equilateral," implies the identification of ABC as a triangle, that is, belonging to a class of geometric figures called triangles, and its classification, because of the stated property, as an equilateral triangle. As a third example, consider the statement, "the function $x+2$ is a linear function." The statement implies the identification of $x+2$ as a function, and the classification of $x+2$ as a linear function in terms of the property linear function.

Proposition II. *Entities* x_i $(i=1,2,3,\cdots, k)$ *have property* P. The proposition is equivalent to the statement, some x's have property P. It may imply, in the case that n is the number of x's in the class C_x and $k=n$, that all the x's have the property P, or, in the case $k<n$, that a subclass of C_x has property P. For $i=1$, Proposition II reduces to Proposition I.

Proposition II involves identification and classification of the entities x_i with respect to the property P. For example, the statement, "the equation $f(x)=0$ has integral roots," implies that the class C_x constituting the roots of the equation $f(x)=0$ contains some elements which are integers. These elements are classified with respect to the given property, namely being the roots of the equation $f(x)=0$. The determination of the roots is another matter. As a second example, consider the statement, "the steel production for the week ending with December 23 was 80 per cent of capacity." The statement implies that each of the steel mills x_1, x_2, x_3, $\cdots$, is operating at 80 per cent of its capacity. It is true that any mill x_r may have varied in its production from the stated 80 per cent rate, yet for the purpose of classification its production must be considered as 80 per cent of capacity.

Proposition III. C_x *has property* P. The proposition is equivalent to the two statements: (1) that the x's that have property P constitute a class; and (2) that every member of the class C_x has the stated property P.

Proposition III implies the recognition of the class property P, and the classification of the entities x_i into the class C_x with respect to the property P. For example, the statement, "the class of integers is an ordered class," implies the recognition of the property being ordered, the identification of all integers, infinite in number, as having this property, and their classification with respect to this property into an ordered class. As a second example, consider the statement, "the function $f(x)=ax+b$ is a linear function." The statement implies that all the values of a and b yield functions $f_i(x)$ which are linear, and that $f_i(x)$ constitute a class of functions known as the class of linear functions.

Proposition IV. x *has relation* R *to* y. The proposition is equivalent to the statement that an x belonging to the class C_x and a y belonging to the class C_y are associated with each other according to the relation R.

Proposition IV implies the recognition of x and y as entities belonging to the classes C_x and C_y, respectively, the understanding of the nature of the relation R, and the association of x and y with respect to the stated relation. For example, the statement, "the number pair (x_1, y_1) defines the point $P(x_1, y_1)$ in a plane," implies: (1) that x_1 is an element of the ordered class C_x of real numbers, ordered on a horizontal axis; (2) that y_1 is an element of the ordered class C_y of real numbers, ordered on a vertical axis; (3) that the point P is defined as the intersection of two lines respectively parallel to the x-axis and y-axis; and (4) that one of the intersecting lines passes through the point on the x-axis whose abscissa is $x=x_1$, and the other line passes through the point on the y-axis whose ordinate is $y=y_1$.

As a second example, consider the statement, "$x=-5$ is the real zero of the function $f(x)=x+5$." The statement implies: (1) that $f(x)$ is a linear function belonging to the class $f(x)=ax+b$; (2) that $x=-5$ is an element of the ordered class C_x of real numbers represented on the x-axis; (3) that the real zero of a function is the abscissa of the point which is the intersection of the curve of the function with the x-axis; and (4) that $x=-5$ is the abscissa of the point of intersection of the line $f(x)=x+5$ with the x-axis.

Proposition V. x_i $(i=1, 2, 3, \cdots, k)$ *has relation* R *to* y_j $(j=1, 2, 3, \cdots, l)$. The proposition is a generalization of Proposition IV. It means that each of the x's belonging to the class C_x is associated with a y (not necessarily the same y) belonging to the class C_y, according to the relation R. The proposition does not exclude the possibility that x_i are related to the same y. For $i=j=1$, Proposition V reduces to Proposition IV.

Proposition V implies Proposition II twice, since x_i belonging to the class C_x have property P_x, and y_j belonging to the class C_y have property P_y. In this case $P_x=P_y=R$, the stated relationship. It also implies Proposition IV, since the relationship R associates separately each x with a corresponding y.

Examples of Proposition V are tables of numerical data establishing a relationship between two variable quantities, empirical formulas which are true only for the observed data, or probably true for additional interpolated values within the proper ranges of the variables.

Proposition V is the statement of specific relationships and laws of correspondence and dependence.

Proposition VI. *Class* C_x *has relation* R *to class* C_y. This proposition states that every entity x belonging to the class C_x is related to one or more entities y belonging to the class C_y. Proposition VI is used to compare two classes by establishing a correspondence between their elements. If each element of the one class corresponds to an element of the second class, the correspondence is a one-to-one correspondence, and the classes are equivalent.

Proposition VI implies Proposition III, and also Proposition IV and Proposition V. Proposition VI is a statement of mathematical functions, since the definition of a function explicitly requires that every x belonging to the class C_x be related to one or more y's belonging to the class C_y. It is also the statement of generalization of empirical relationships.

Proposition VI may be considered as the statement of a transformation, which, by means of the stated relationship R, transforms every x into a y.

Propositions I–III undertake to study the relationships between the elements of a given class, and lead naturally to the fundamental concept of group. Propositions IV–VI undertake the study of relationships between the elements of two given classes, and thus lead to the study of transformations and functions.

Propositions I–VI, though herein stated mathematically, are manifested everywhere and every time that thinking takes place, for reflective thinking, as stated above, is relational thinking and relation-

al thinking, as herein analyzed, is thinking in terms of properties of entities or relationships between them. Without some degree of relationship thinking in ordinary life, there is nothing in the mental process which merits the name thinking. In the strictest sense, to think means to think relationally.

Relational thinking in mathematics is a prototype of excellence or standard for similar thinking in other fields. The entities in mathematics, in terms of which thinking is done, are readily discernible, their properties are precisely known and can be stated concisely, their relationships, when stated mathematically, are exact, their nature comprehensible, and their implications predictable. Consequently, mathematical instruction can contribute in a definite manner to the attainment of relational thinking, provided relational thinking is a definite objective of mathematical instruction, and of the educational system.

The teachers of mathematics, both in colleges, and secondary schools, have a unique educational function to perform, a function that may be supplemented by the teachers of other subjects, but can not be replaced by them. That much is an obvious truth, which one can observe even in the acrimonious discussions, usually by those least capable to judge, concerning the educational aims, merits, and purposes of mathematics. However, one criticism, and one alone, directed against mathematical instruction, the teachers of mathematics can not ignore and must face. The criticism is, that the type of mathematics taught in our colleges and secondary schools is not the mathematics of relational thinking. That criticism we the teachers of mathematics must admit is justified and has merit of acceptance.

In our junior colleges, the students may be classified with respect to mathematics into two main classes, namely, class C_x consists of those who take one or more courses in mathematics and class C_y consists of those who take no courses in mathematics. Let us analyze these two classes with respect to the relation R, namely, relational thinking.

By Proposition II, many students in the class C_x will acquire the art of relational thinking, but not necessarily all. In other words, Proposition II is necessary for the existence of Proposition III, but not sufficient. Our problem as the teachers of mathematics is to make Proposition III in this case true. To do that, relational thinking must be an explicit objective of every course in the junior college, since by assumption some students will take only one course. Now the question that we must truthfully answer is: does Proposition I hold with respect to any given course in college mathematics? That is, does any given course in college mathematics have the property of being a relational thinking course? Is college algebra such a course? Is trigonometry? Is analytical geometry? The question is not whether or not college algebra can be organized along functional lines and taught as a relational thinking course, but whether or not the classical, the traditional college algebra, as represented by a typical text and taught in a typical college, is a relational thinking course.

When we consider the class C_y, namely, the class of students who will not take any mathematics courses in college, we are led back to our original assumption and can draw a conclusion on that basis. If mathematics is the only subject best adapted for training in relational thinking, then unless previously acquired in high school, a dubious conclusion, the students in the class C_y will be deprived of acquiring the art of relational thinking. On the other hand, if some of them do acquire it, then we must modify our claims concerning the educational merits of mathematics in relational thinking, and modify our fundamental assumption.

If the second of the two conclusions stated above is true, namely, some students in the class C_y will acquire relational

thinking, and evidence so far shows that this is a reasonable conclusion, then it is reasonable to assume that there is a definite relationship between the class C_y and C_x with respect to relational thinking. If physics or chemistry, or zoology, or sociology can train the student of the class C_y in relational thinking, then the teacher of mathematics, who trains the student in the class C_x in relational thinking, and the teacher of physics, and of the other subjects should analyze relational thinking, as we have attempted to do, and endeavor to supplement each other's special training. By Proposition VI, in this case, there is a relationship R, a correlation, between the classes C_x and C_y that needs determining.

The training of the teacher of junior college mathematics for relational thinking, it seems, should include the following:

1. The teacher of mathematics should make relational thinking a definite objective of every course that he teaches. This may necessitate a reorganization of some or all of the traditional courses.

2. The teacher of mathematics should make relational thinking a definite objective to be attained by all of the students in his classes. This may necessitate a modification of the methods of instruction.

3. The teacher of mathematics should devise adequate tests to evaluate instruction in order to determine whether or not every student in his classes has acquired relational thinking. This may involve special training in the determination of learnings and in the formulation and analysis of tests.

4. The teacher of mathematics should study the possibility of offering a course in relational thinking to those students who at present do not take the traditional courses. This may mean the organization of a course along the lines of the so-called survey or cultural courses in mathematics.

5. The teacher of mathematics should enrich the courses he teaches by bringing materials from other fields as applications in relational thinking. This may mean a revision of some of our present courses. It is not enough to bring applications only from the physical sciences. Serious efforts are being made at the present time to make economics an exact science. The teacher of mathematics should be familiar with the fields of applications of mathematics and enrich his courses accordingly.

6. The teacher of mathematics should know and use the correlations between his subject and other subjects engaged in training relational thinking. Coordination of effort is needed in educational systems. We the teachers of mathematics are to a great extent responsible for the state of affairs. We should not be too absorbed in our adoration of the muse of mathematics to be blinded to our surroundings and to the needs of those who have not been initiated into the order of the Pythagoreans.

Mathematics has a mission to fulfill in the educational scheme. It can train in relational thinking perhaps better than other subjects. It should train not a handful of students, who will be future mathematicians and engineers, in relational thinking. It owes something to the students of general education in the junior college. If we must change and reorganize our present courses to fulfill that mission, then we should not hesitate to do so. If we must have our teachers trained for relational thinking along different lines than at present, then we should demand such training of our teacher training institutions and universities. Talking about the significance and importance of relational thinking is not enough. The National Council of Teachers of Mathematics and the Mathematical Association of America should become leaders in the movement to make such a program a reality.

The complete program for the Annual Meeting of the National Council of Teachers of Mathematics to be held at the Hotel Chelsea in Atlantic City, N.J., from February 20th to 22nd, 1941 will appear in the February issue of The Mathematics Teacher.

The Performance of the Mathematics Candidates in the 1940 National Teacher Examinations[1]

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PROBABLY every superintendent of schools has often wished for some measure of the the ability and knowledge of the applicants who offer themselves for positions on his staff which would be comprehensive, accurate, and comparable from applicant to applicant. In order to help meet this need, the American Council on Education in the spring of 1939 appointed a National Committee on Teacher Examinations and authorized it to supervise and delegate to the Cooperative Test Service the task of preparing a battery of objective tests for the examination of teacher candidates.

During the summer, fall, and winter of 1939 plans and outlines for these examinations were drawn up, items were written and tried out, and the final forms were prepared for administration on March 29 and 30, 1940.[2] The items were written by a staff trained in the subject matter concerned and also in the technical aspects of test construction, with the advice and assistance of subject-matter experts, members of the faculties of teacher-training institutions, supervisors in city school systems, and classroom teachers. The test materials were given an experimental tryout in order to obtain some information about their difficulty and to insure a high item validity in the final forms.

Examinations were constructed to cover the following areas: nonverbal reasoning ability, understanding and use of the English language, general cultural information, knowledge of present-day problems and practices in the field of education, knowledge of contemporary happenings and current social problems, and mastery of the subject matter to be taught by the particular candidate. No attempt was made to include any measure of personality or character in this first battery; the local authorities made their own provision for rating these factors as well as training and experience. Each school system participating also made its own decision as to the relative weights to be given these objective examinations and the interviews, practical demonstrations, and other evaluation techniques available to them.

Of the 3726 candidates examined in March 1940, 463 took the special subject examination in mathematics. As each candidate for a high school position took two special subject-matter examinations, he was given an opportunity to indicate whether mathematics was his first or second choice as a teaching field; 345 candidates gave it as their first choice and 118 as their second. A discussion of the relative achievement of these two groups is given later in this report.

Since all scores are reported in terms of Scaled Score units,[3] it is possible to make

[1] For a discussion of the origin, general purpose and plan, administration, and general results of these examinations, see David G. Ryans, "The Professional Examination of Teaching Candidates; A Report of the First Annual Administration of the National Teacher Examinations," *School and Society*, LII, 1345 (October 5, 1940), 273–284; and John C. Flanagan, "An Analysis of the Results from the First Annual Edition of the National Teacher Examinations," *Journal of Experimental Education*, March 1941, (preprints available from the National Committee on Teacher Examinations, 15 Amsterdam Avenue, New York, N. Y.).

[2] The 1941 examinations will be given on March 14 and 15. For information, communicate with the National Committee on Teacher Examinations, 15 Amsterdam Avenue, New York, N. Y.

[3] "The (raw) scores were converted so that a score on one test would be similar in meaning to a corresponding score on another test. A Scaled Score may be regarded as a score which has been adjusted to a common scale having a range of approximately 100 points on which a score of 50 represents an average value for these *achievement tests* similar in meaning to the IQ of 100 for intelligence tests (the average of an unselected group of individuals taking an intelligence test)." National Committee on Teacher Examinations, *Memorandumon Use of Examination Results*, May 1940.

See also John C. Flanagan, *The Cooperative Achievement Tests: A Bulletin Reporting the*

a direct comparison between the scores of the mathematics candidates and those of the other subject-matter candidates on the common examinations concerned with general background. Table I gives the median Scaled Scores obtained by each of the subject-matter groups on the tests of the common battery and on the special subject-matter tests. An examination of these results shows that the mathematics group is outstanding in nonverbal Reasoning and in the Mathematics section of the General Culture test, and is one of the three highest groups in Professional Information. This group is also well prepared as far as subject matter is concerned since it exceeds all but the French, German, and Latin groups. As might be expected, the mathematics group falls slightly below the median for the total group on the Literature and Fine Arts sections of the General Culture test.

TABLE I

Median Scaled Scores of the Subject-Matter Groups on the Tests of the 1940 Battery of National Teacher Examinations

Group	No. of Candidates	Reasoning	English Comprehension	English Expression	General Culture						Professional Information	Contemporary Affairs	Special Subject Option
					Current Social Problems	History	Literature	Science	Fine Arts	Mathematics			
Education in the Elementary School	579	57	59	60	56	56	59	56	61	57	59	56	59
English Language and Literature	1126	59	69	67	65	66	71	60	67	61	64	65	67
Social Studies	1090	59	66	62	67	69	66	60	64	61	64	67	64
Mathematics	**463**	**71**	**64**	**61**	**64**	**63**	**61**	**68**	**61**	**79**	**66**	**65**	**68**
Biological Sciences	351	62	65	59	64	63	61	72	61	66	63	64	63
Physical Sciences	342	66	66	60	66	64	60	77	61	76	66	68	65
French	270	60	69	71	63	63	71	57	68	62	64	63	69
German	74	60	70	69	64	65	67	61	67	64	61	64	70
Spanish	67	59	68	64	60	66	67	56	64	59	62	63	66
Latin	148	60	72	74	64	64	72	59	65	65	66	63	73
Total Group		60	64	61	62	62	63	60	63	61	63	63	

Table II shows the Scaled-Score and raw-score distributions for the mathematics candidates on the 90-minute special subject test in mathematics. The Scaled Scores corresponding to the 95th, 75th, 50th, 25th, and 5th percentiles are given at the left. The group includes all candidates who elected mathematics as an option. The test consisted of three thirty-minute parts: I, basic facts and concepts, which tested for a knowledge of mathematical theory (45 items); II, problems, which tested ability to apply facts and concepts to practical problems of everyday life (25 items); and III, subject-matter integration, which tested ability to give clear explanations, to apply the theory of higher mathematics to high school mathematics, and to understand the problems involved in teaching mathematics (35 items).

The raw scores were computed by subtracting one-fourth of the number of wrong responses from the number of correct responses. This subtraction was made in order to correct for guessing. The raw scores of the candidates ranged from 0 to 95 out of a possible 105. Approximately two-thirds of the candidates made raw scores between 17 and 57, and the mean raw score was 37. Therefore, even though the mathematics group as a whole did well on the examinations, there are nevertheless great differences in subject-matter knowledge among the various candidates offering themselves as prospective teachers of mathematics; the distribution shows that about 25% of the candidates knew the an-

Basic Principles and Procedures Used in the Development of Their System of Scaled Scores. New York: Cooperative Test Service, 1939.

TABLE II

Distribution of Mathematics Candidates on the Subject-Matter Test in Mathematics of the 1940 National Teacher Examinations

	Scaled Score	Raw Score Max. = 105	Frequency
	96	95	1
	94	91	3
	92	86	6
	90	82	4
$P_{95} = 88$	88	77	14
	86	72	11
	84	67	10
	82	62	19
	80	57	13
$P_{75} = 77$	78	52	25
	76	46	31
	74	41	32
	72	37	25
	70	34	22
$P_{50} = 68$	68	31	28
	66	28	36
	64	26	24
	62	23	31
$P_{25} = 60$	60	21	19
	58	19	26
	56	17	20
	54	15	15
	52	14	11
	50	12	11
$P_5 = 49$	48	10	9
	46	9	1
	44	7	6
	42	5	6
	40	4	1
	38	2	1
	36	1	1
	34	0	1
Number of cases			463
Median			31.8
Mean			36.9
Standard Deviation			20.4

swers to fewer than 22 of the 105 questions on the test, even though the range of difficulty of the items was such as to include a number of fairly easy ones.

In connection with this question of range of scores, it is interesting to compare the performance of those who gave mathematics as their first choice with the performance of those who gave it as second choice. Table III shows the scores of these two groups on the common examinations, and the graph below indicates their performance on the special subject test in mathematics. Except in nonverbal Reasoning and the Mathematics section of the General Culture test, the two groups are fairly similar on the common examinations. On the special subject test, there is a difference of about 10 Scaled Score points in favor of the first-option group. However, about 20% of the second-option group exceed the median of the first-option group.

In order to present the type of materials covered by the special subject test in mathematics, several items are given below. At the right of each response are recorded the percentages of people in the upper and lower 25% of the distribution choosing that response. (H = upper 25%, L = lower 25%, NR = not reading item.)

1. The sine of an angle

	H	L
(1) **changes more rapidly between 0° and 45° than between 45° and 90.°**	*64*	*4*
(2) varies between $-\infty$ and $+\infty$.	*3*	*6*
(3) is equal to the cosecant of its complementary angle.	*16*	*19*
(4) is not a continuous function.	*4*	*2*
(5) is the reciprocal of the cosine of that angle.	*1*	*23*
Omitted	*5*	*17*
NR	*7*	*29*

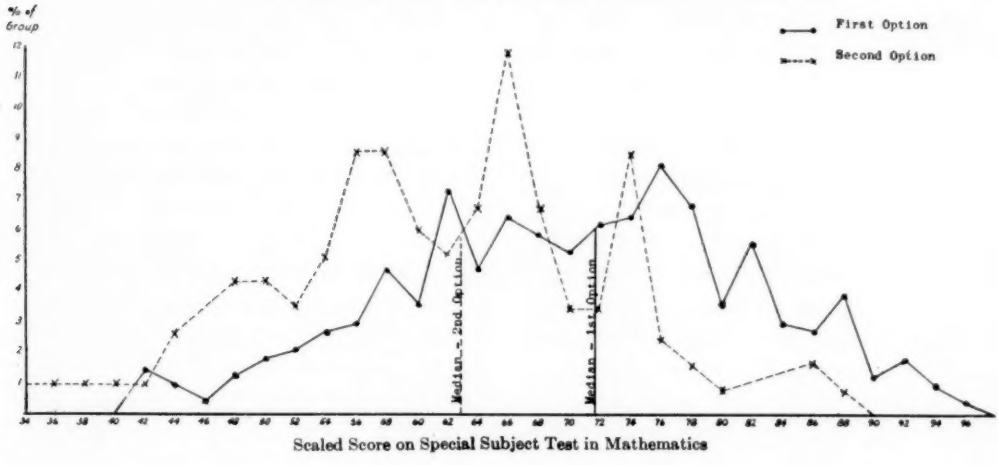
2. The illumination from a source of light varies inversely as the square of the distance from the source, or $I = K/D^2$ where D is the distance. If a book is 10 ft. from a lamp, at what distance from the lamp must it be placed in order that the light on it be doubled?

TABLE III

Median Scaled Scores on Common Examinations for Candidates Selecting Mathematics As First Option and Second Option

				General Culture							
	Reasoning	English Comprehension	English Expression	Current Social Problems	History	Literature	Science	Fine Arts	Mathematics	Professional Information	Contemporary Affairs
Math. 1st Option	71.9	64.2	61.2	64.3	62.7	60.6	68.5	60.7	80.1	66.7	64.1
Math. 2nd Option	66.1	64.6	60.2	65.1	64.0	60.4	66.6	60.0	76.8	65.2	66.4

Distribution of Scaled Scores on the 1940 National Teacher Examination in Mathematics for Candidates Selecting Mathematics as First and Second Options



	H	L
(1) $2\sqrt{5}$ ft.	4	11
(2) 5 ft.	2	10
(3) $5\sqrt{2}$ ft.	**86**	**22**
(4) 50 ft.	2	3
(5) Solution impossible.	4	21
Omitted	2	33

3. Which one of the following additional pieces of information would be *most* helpful in finding the surface area of a regular hexagonal pyramid one side of whose base is 6?

	H	L
(1) The volume of the pyramid	0	2
(2) The altitude of the pyramid	12	33
(3) The area of the base	2	6
(4) The radius of the circumcircle of the base	0	1
(5) The slant height of the pyramid	**84**	**43**
Omitted	2	15

4. If the equation $x^2-2x-4=0$ is transformed by diminishing the roots by 2, this has the effect of

	H	L
(1) shifting the curve 2 units to the right and preserving its form.	6	5
(2) changing the form of the curve.	6	11
(3) shifting the curve 2 units to the left and preserving its form.	**80**	**24**
(4) shifting the curve up 2 units and preserving its form.	1	4
(5) shifting the curve down 2 units and preserving its form.	0	7
Omitted	7	48
NR		1

Summary. The performance of the mathematics candidates on the 1940 National Teacher Examinations may be characterized as follows:

1. The average of the group is superior to the average of the whole group of candidates in nonverbal Reasoning, the Mathematics section of the General Culture test, and Professional Information.
2. The median for the group is slightly below the median for all the subject-matter groups together on the Literature and Fine Arts sections of the General Culture test.
3. There is a wide range of subject-matter mastery among candidates for positions as mathematics teachers.
4. The background preparation of the groups choosing mathematics as first and second options seems to be about the same (except in mathematics).
5. The median of the first-option group in the subject-matter test in mathematics is substantially higher than that of the second-option group.
6. Twenty per cent of the people in the second-option group made scores on the subject-matter test which were higher than the median of the first-option group.

Mathematics for Everybody

By AGNES MACNEISH
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MUCH discussion and experimentation are in process in regard to fitting the high school work in mathematics to the needs of the pupils. Having the right kind of mathematics for everybody is generally recognized as one of the aims of the curriculum. There is accordingly a very great need for a reorganization of high school mathematics with a view to adjusting the offerings of the department to the different levels of ability and preparation occurring among high school students and to the many uses for mathematics in present day living.

It should, therefore, be of interest to those who sincerely want to benefit the pupils to know what one school has done to make this adjustment. The plan in operation at Tilden Technical High School in Chicago has long since passed from the experimental stage to that of an established plan. This plan is quite definitely worked out and has been in operation for a number of years.

Tilden felt this problem probably earlier than most schools partly because two years of mathematics were required for graduation from a technical high school and partly because a technical high school serves pupils with such a wide range of abilities. The boy more capable with handwork than headwork, the boy more gifted mentally who seeks preparatory work for entrance to an engineering college, and the average boy who wants a well-rounded foundation for any career which may follow the completion of his high school work—all find their way into a technical high school. These circumstances make it evident that this problem of suitable mathematics for everybody was always here.

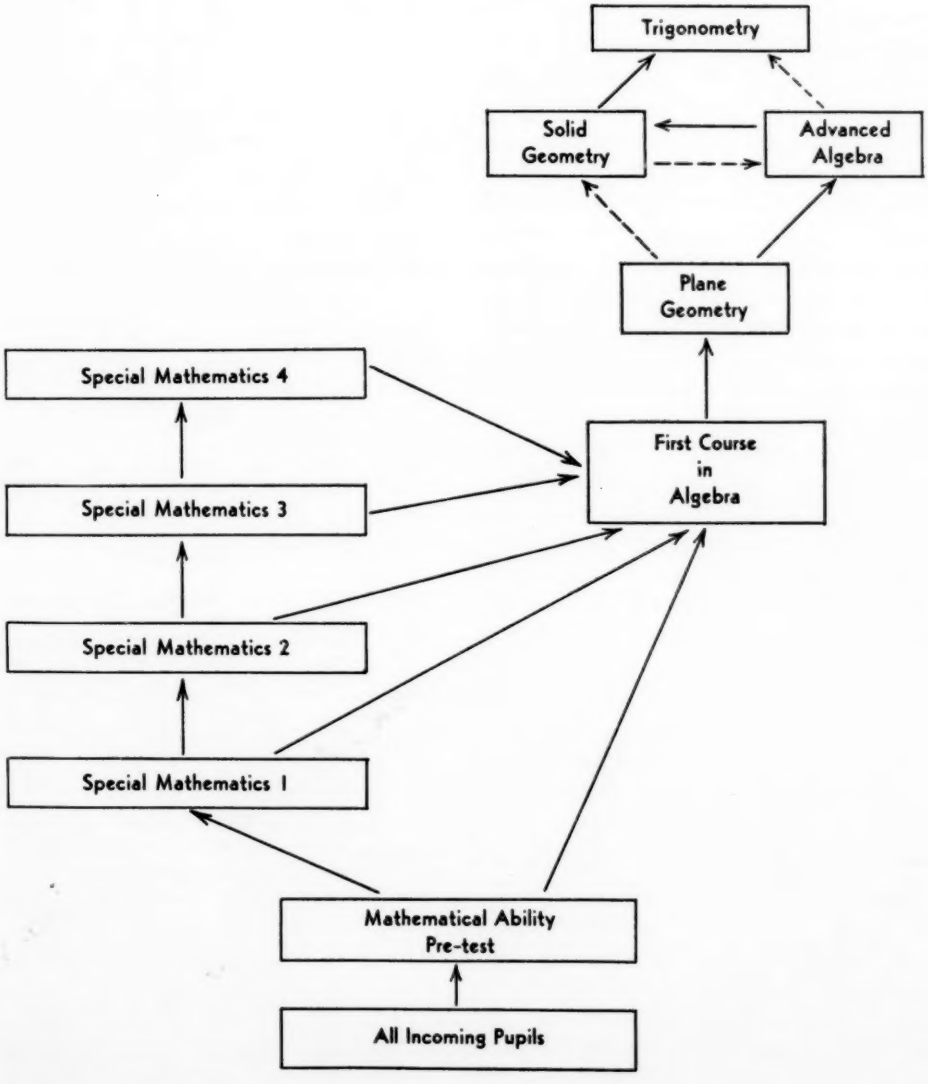
The solution of Tilden's problem evolved out of an experiment with a special first course conducted by Elizabeth Marston in her own classes in the school year of 1929–30. An outcome of that study was the adoption of a special course in the department as a whole for those pupils who for one reason or another seemed not to be properly equipped for the regular first course in algebra. Hence there came to be two first courses in high school mathematics at Tilden: one, the regular first course in algebra; the other, a special course for those who were either not ready for or not capable of doing the algebra at the time of entrance into high school. This special course was called shop mathematics. That name implied a content limited to the needs of a technical high school. As a matter of fact this course was much broader in scope and easily adaptable to any high school. It is now called special mathematics.

For a while there was one year of such work at Tilden. But the pupils who took this course, as well as all other Tilden pupils, had to have two years of mathematics for graduation. This meant that for certain pupils the special course was followed by a year of algebra to meet the graduation requirements. It was found that, even with the algebra coming one year later in the high school curriculum, many of these pupils still had difficulty with it. A problem still existed. The teachers themselves petitioned that the work be extended to include a second year. A committee was appointed for this purpose composed of Frances Hubler, Stella Johnson, Drusilla Keller, Elizabeth Marston, Mabel Simcox, and Burton Duffie, chairman. The department as a whole consisting of more than twenty teachers discussed and passed on the work of the committee. So this special course was worked out by the teachers in the department who

were in daily contact with the pupils for whom the course was intended and who knew first hand the needs, abilities, and interests of those pupils. The success of the work has in large measure been due to the fact that it has been a co-operative project to meet a current need. In 1936 the superintendent of schools of Chicago approved this special course for the second year. Since that time Tilden has had not only two first courses in mathematics but two parallel sequences in mathematics: one, a two-year sequence in the special mathematics; the other, the usual three-and-a-half-year sequence including algebra, plane geometry, advanced algebra, solid geometry, and trigonometry. It is the former of these two sequences that is of interest here. The *department tree* which follows gives an eye-picture of the plan.

The offering of two first courses in mathematics gave rise immediately to the problem of differentiation between the groups for the different sequences. An appraisal of entering pupils as to mathematical ability was necessary. Various

THE DEPARTMENT TREE



tests have been made use of including intelligence tests, standardized computation tests, and arithmetic reading or problem analysis tests. At the present time there is being used a test of mathematical ability made under the supervision of Mr. Tower when he was district superintendent of high schools. A study was made of the relation between scores made on this test and success grades in the first semester of algebra. A critical score was established for probable success in algebra. Those pupils who make a score less than that critical score are registered for the special mathematics. Always, however, there is opportunity for readjustment on the basis of actual classroom performance and recommendation by the class teacher. The test score is not a hard and fast criterion but merely a practical guide to a trial registration. It should be added that remarkably few readjustments have had to be made. Recently the cumulative records have been coming from the grammar schools and it may be that they will furnish a satisfactory basis for proper registration in high school mathematics without the necessity of a high school pretest.

Just what do the pupils study in the different mathematics courses? If they have started the algebra-geometry sequence, their work will be much the same as that done elsewhere by algebra and geometry classes and needs no description here. The content of the special mathematics courses will, however, be given in some detail. First a general statement. The primary aim at the outset is to make up deficiencies in arithmetic. This done, the aim is to keep this arithmetic ability alive by application to situations consistent with the age level of the pupils. The pupil is also made acquainted with the use of algebraic symbolism in easy settings, is introduced to the negative number, and given graphical work visualizing the meaning of the negative number. In the third semester emphasis is put on the mathematics used in leisure, merchandizing, transportation, investments, and public finance. This is a semester of social and socialized mathematics. The topics are applied to the activities of the pupil in school and in the home as far as possible. The last semester teaches the use of the slide rule, the compass, ruler, protractor, and squared paper. Its subject matter is non-demonstrative geometry. It includes concepts, construction, and both direct and indirect measurement. At all times the course as a whole aims to offer worthwhile material commensurate with the ability of the pupil. An effort is made throughout to correlate the work not only with that of other departments in the high school but also with all activities in which the pupils may participate outside of school. It is felt that the content is such that the pupils receive valuable training in worthwhile mathematics throughout the four semesters of the special mathematics sequence. A brief outline without elaboration of topics follows.

SEMESTER ONE

UNIT 1—Decimals
UNIT 2—Fractions
UNIT 3—Changing fractions to decimals and vice versa
UNIT 4—Use of formulas
UNIT 5—Mensuration
UNIT 6—Graphs and the meaning of negative number
UNIT 7—Simple equations

SEMESTER TWO

UNIT 1—Direct measurement including use of metric system
UNIT 2—Fractions reviewed with new applications
UNIT 3—Signed numbers—the four operations
UNIT 4—Equations
UNIT 5—Ratio and proportion

SEMESTER THREE

UNIT 1—Mathematics of leisure
UNIT 2—Mathematics of merchandizing
UNIT 3—Mathematics of transportation
UNIT 4—Mathematics of investment
UNIT 5—Mathematics of public finance

SEMESTER FOUR

UNIT 1—Slide rule
UNIT 2—Angles
UNIT 3—Line segments
UNIT 4—Perpendicular lines

UNIT 5—Parallel lines
UNIT 6—Parallelograms
UNIT 7—Triangles
UNIT 8—Polygons
UNIT 9—The common solids

Many desirable outcomes have resulted from having this plan of two sequences in mathematics. It has met the problem of individual differences in a practical and effective way. Every pupil has the opportunity to take the course better suited to his needs. The pupils' attitude toward mathematics has thereby been improved. The number of pupils receiving suitable mathematical training has been increased. Pupils who would otherwise have been failures in algebra have been successful in mathematics. Pupils unable to take algebra at the time of entrance into high school have been prepared to take it at a later time. And last, but not least, the scholastic standards of the regular course in algebra have been raised by the elimination of those pupils who are required to take mathematics but who are not qualified to take the algebra as a first course in high school mathematics. Therefore the plan has benefited either directly or indirectly all of the pupils.

THE ALGEBRA OF OMAR KHAYYAM

By DAOUD S. KASIR, Ph.D.

The author of the *Rubaiyat* was also an astronomer and mathematician. This work presents for the first time in English a translation of his algebra. In the introduction, Mr. Kasir traces the influence of earlier Greek and Arab achievements in mathematics upon the algebra of Omar Khayyam and in turn the influence of his work upon mathematics in Persia in the Middle Ages. The translation is divided into chapters, and each section is followed by bibliographical and explanatory notes.

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Statistics for Ninth Grade Pupils

By RICHARD M. DRAKE
University of Buffalo, Buffalo, New York

DURING a period of six years the writer has attempted to develop a unit of instruction based upon statistical concepts. This project was carried on at the University of Minnesota High School with ninth-grade mathematics pupils. Since many teachers have evinced an interest in the procedure employed, it was deemed advisable to put in written form the objectives and teaching methods utilized.

The following general objectives were set up:

1. To show the usefulness of a precise numerical description of a group when measures are given for each individual in the group.
2. To teach students to arrange data so that they can be better understood and used.
3. To determine values which are representative and typical of the entire set of data.
4. To compute other values which give a better interpretation to the individual items which compose the data.
5. To show the students the limitations of such statistical procedures and possible misleading conclusions.
6. To show the need for exercising judgment and common sense in computing from approximate data.
7. To train the pupils in habits of accuracy and neatness.
8. To aid the pupils in the acquisition of concepts of statistical measurement and the requisite vocabulary.
9. To arouse an awareness of the widespread use of statistics as a means of expression of ideas.
10. To help the pupil in his understanding of everyday problems by employing social data.

Each year detailed notes were made by observers as the unit was taught. These notes were then organized as a plan for the unit, revised, and used as a basis for the next year's teaching. The following is a brief summary of the unit plan as it appeared at the end of the sixth year.

The unit was introduced by a general discussion of the need for arranging data in a form that could be more easily understood and interpreted. Scores on tests given the class were placed on the board in a table form. It was brought out that a score of 22 on a test did not mean much by itself. It might be near the top and it might be very poor. Some idea of the value of the score might be obtained by a cursory examination of the entire group of scores but since they were not arranged in any particular form, such a procedure would not be of much value. The score must have position attached to it. The pupil must be able to picture the entire group at one time and to place his score in the picture. Order must be created out of chaos.

The discussion led up to the histogram as a means of depicting the achievement of the entire group and the desirability of so constructing the histogram that the pupil could identify his score with a certain square in the histogram. The test scores used as a sample and also for the assignment had a range less than 20 so that the idea of the interval was not introduced. The next set of data placed on the board was of such a nature that the range was greater than 20. The need for an interval distribution of more than one point was apparent. The base line of the histogram would be too long if the range was 39.

The standard procedures for making a frequency distribution and determining the size of interval to be used were presented to the students. This was followed by a short oral drill on determining what intervals would contain certain scores. The interval 38–39 was referred to as the interval 38 through 39. It was pointed out to the pupils that the score which occurred

or was obtained most often was called the mode—the most fashionable score.

Next the pupils were given mimeographed sheets of test scores. These were their own scores on five tests taken during the first half of the semester. Since these data were to serve as a basis for future assignments, the students were referred to by a number rather than by name.

The following discussion was used to introduce the idea of average. For today we made a histogram of scores on a test. This presents test results in a better form than the recorded scores. It might be termed a group picture of the achievement of the class. However, it would be more desirable to indicate a score which would be called the average for the class. (Several students in the class had already requested the average for the test.)

In your past experiences you have encountered this idea of average. What are some of the situations that you can recall in which an average has been employed?

1. Average temperature for a month $= \frac{\text{total of temperatures}}{\text{total number of days}}$

2. Average number of miles per gallon of gas $= \frac{\text{total number of miles}}{\text{number of gals. used}}$

3. Average weight of a group of people $= \frac{\text{total of their weights}}{\text{number of people}}$

4. Average yards gained in football $= \frac{\text{total yards gained}}{\text{number of attempts}}$

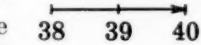
In general then we can find an average by dividing the total of whatever we are using by the number of cases involved.

The illustrative material on the blackboard is composed of temperatures on a given day for cities grouped according to sections of the country. How would you proceed to compute the average temperature for the cities in the West Central States on that day? This average was worked out at the board and then the students at their seats figured the other two averages. Comparisons were then made between the results for the various sections.

Another set of data on the board consisted of the hourly temperature for Minneapolis for twelve consecutive hours. This data led over to the use of the frequency distribution as an aid in determining an average.

A formula was developed for finding the mean using the letters M for mean, x for score, f for frequency, N for number of cases and the summation symbol $\sum$. It was explained to the pupils that $\sum fx$ meant the sum of the products of f and x.

This was followed by the computation of the mean when the size of the interval was greater than one. One or two questions sufficed to bring out the fact that now we should take the midpoint of the interval times the frequency. The interval 38–39 was defined as including all scores through 39 up to but not including 40. A picture of the interval was drawn on the board.



This aided in clarifying the idea of the midpoint of an interval. A formula for determining the midpoint was developed. $m = L + i/2$ where m stands for midpoint, L for lower limit of the interval, and i for the size of the interval.

The computation of the mean was then completed and a formula for this procedure was derived. $M = \sum fm/N$.

The next topic was the use of the guessed average as a short cut in finding the value of the mean. The following discussion was employed:—

So far we have used two methods for determining the mean of a distribution of scores. The one is by taking a total of the scores on the mimeographed sheet and dividing by the number of cases. The

second method is to assume the midpoint of the interval as the score obtained by all the students in that interval, multiply the frequency times the mid point, total these products, and divide by the number of cases. On the test for October 16 the total from the mimeograph sheet is 3413 which when divided by 78 gives a mean of 43.8. The products under the second method total to 3447 which gives a mean value of 44.2.

Oct. 16

	f	*d*	*fd*
72–74	1	9	9
69–71	0	8	0
66–68	1	7	7
63–65	0	6	0
60–62	9	5	45
57–59	2	4	8
54–56	5	3	15
51–53	6	2	12
48–50	6	1	6
45–47	6	0	102
42–44	10	−1	−10
39–41	5	−2	−10
36–38	4	−3	−12
33–35	6	−4	−24
30–32	7	−5	−35
27–29	4	−6	−24
24–26	3	−7	−21
21–23	1	−8	− 8
18–20	2	−9	−18
			−162

$$\text{Mean} = 46.5 + \frac{(102 - 162) \times 3}{78}.$$

A third method is to assume the midpoint of some interval as the mean. Let us assume the interval as the average which makes our guessed average 46.5. Now the value 46.5 may be too high or it may be too low. The question is can we find out the size and direction of our error? We assume that the 6 pupils in the interval 45–47 obtain scores of 46.5. In other words they score exactly at our guessed average. The 6 pupils in the interval 48–50 we assume to score 49.5 each. This puts them one interval above the guessed mean. The 6 pupils in the interval 51–53 deviate two intervals etc. However, the 10 students in the interval 42–44 are one interval below the guessed mean, etc. The 6 people each one interval above the mean total in all 6 intervals from the assumed mean, the 6 each two intervals above, total in all 12 intervals, etc. Then how shall we represent the total of these 10 pupils each one interval below the mean? The 5 each two intervals below?

Total the positive deviations and the negative deviations separately. If the positive deviations total more than the negative deviations from the guessed average, what must be true of the value which we have guessed as the mean? Was it guessed too high or too low? If the reverse is true, then the mean has been chosen too high. Suppose the total of the positive deviations is equal to the total of the negative deviations, then what is true?

Add algebraically the two totals and divide by the number of cases and this will give you the average of the deviations which is the amount of the error of our guess. But this error is in terms of intervals. Therefore, we must multiply the error by 3 to translate it into points. Combine this error expressed in points with the guessed average, 46.5, and this gives us the value of the mean. A formula for this method was also developed.

$$M = G.A. + \frac{\sum fd}{N}(i)$$

At this point in the unit it appeared that the pupils had a fair understanding of the steps involved in determining the value of the mean by various methods. It was thought advisable to introduce a different type of data to work with. The students received mimeographed sheets of directions and questions. Values such as the following were used, prices received by American farmers for butter, eggs, and chickens; retail food prices for the same products; temperatures; precipitation; heights and weights of children.

The computation and the questions interpreting the tables created the need for

additional information on two topics. The first, rounding off numbers; and the second was, how numbers or quantities are compared. Under the second topic it was brought to the students' attention that two values can be compared as a result of division or subtraction.

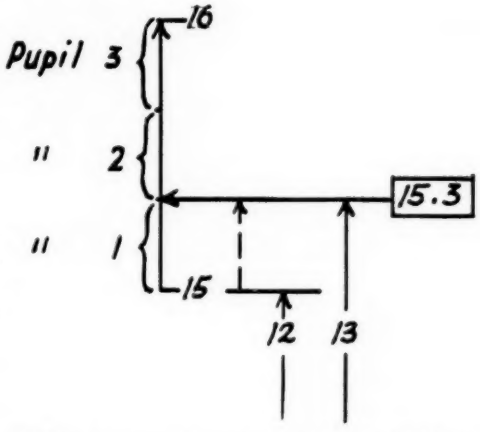
In connection with the procedure for finding the value of the mean by the use of a guessed average, some of the pupils suggested counting up one-half of the number of cases to determine the guessed mean. This led to another average; namely, the median. This average was defined as the score below which 50% or half of the group achieved.

The temperature for nine cities was placed on the board and the students were asked to figure the median temperature. They decided to re-arrange the temperatures from high to low in order to simplify the process.

This was followed by using a one point interval frequency distribution with the ensuing discussion:—

18	2	
17	3	
16	6	
15	3	
14	4	↑
13	1	12
12	1	
11	2	
10	1	
9	0	
8	0	
7	2	
6	1	
	26	

We wish to find the mid-score or the score below which 13 pupils achieved. Counting up from the bottom, we find that 12 pupils achieved below 15 and 15 below 16. So the value of the median lies somewheres between 15 and 15. We will assume that the three people in the interval are distributed uniformly throughout the interval. An enlargement of the interval would appear as follows:—



When we arrive at the lower limit of the interval, we have used up 12 of the 13 pupils. We therefore have one left to go which takes us one-third of the distance into the interval. The value of the median is then found to be 15.3.

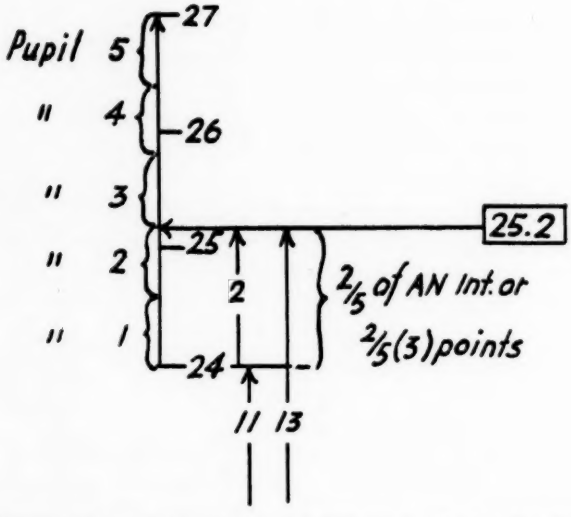
Next let us take a distribution using a three point interval. One half of 26 is 13 and counting up as before from the lower end, we find that 11 pupils scored below the interval 24–26 and 16 below the interval 27–29. Therefore the median must lie in the interval 24–26. The enlargement of the interval could be pictured as follows:—

45–47	3	
42–44	0	
39–41	3	
36–38	1	
33–35	1	
30–32	0	
27–29	2	
24–26	5	
21–23	3	↑
18–20	3	11
15–17	2	
12–14	3	
	26	

We have two left to go after counting up 11 of the 13 to reach the lower limit of the interval. The point below which 13 pupils achieved will be 2/5 of the way into the interval 24 through 26 or it will have a value of $24+2/5(3)$ which equals 25.2.

In more detail the computation is $24+(13-11)/5(3)$. In words this would be:—

$$\text{Median} = \text{lower limit of interval that contains the median} + \frac{\text{no. of cases to be used}}{\text{no. of cases in interval}} \times (\text{size of int.})$$



The following discussion introduced the idea of quartiles:—

If you know that you are above or below the average of the class, you have a general idea of your success or failure on a certain test. But we usually desire to know something further concerning our score in relation to the achievement of the whole group. The median is the point below which 50 per cent or one-half of the class scored. We, can, by a similar process, find the point below which 25 per cent of the class scored, and also the point below which 75 per cent of the class scored. These two points are called the 25th and 75th percentiles or the first and third quartiles. The median would be what quartile?

Usually the pupils obtaining scores above the 75th percentile get grades of A or B and pupils who fall below the 25th percentile get D or F. This however is not a hard and fast rule; there are certain other factors to be considered in assigning grades which will be shown later.

The idea of a profile graph was introduced by this discussion:—

Thus far you have computed the median, 25th and 75th percentiles on several of the tests which you have taken. It would be interesting to find out whether or not you have been improving from test to test; or in other words to discover how your progress compares with that of the class as a whole. To do this we will construct a broken line graph. A broken line is just what the name implies; a straight line that has been broken much as you would break but not disconnect a stick. (Illustrate on board.) We will use the horizontal axis to represent the various tests and the vertical axis the scores. Plot in class points which represent the highest score and the median on the tests. Also show the need for and sketch a cumulative table to bring together all the values which have been determined previous to the construction of the profile graph. The pupils' test scores were used as a basis for the construction of profile graphs.

The difference between the mean and the median was presented by the use of this problem:—

When should the mean be used and when should the median? Are there situations in which one would give a more desirable average than the other? Suppose we have a department store with salaries or wages ranging from \$10.00 to \$109.00 per week and distributed as follows:

100–109	11
90– 99	0
80– 89	0
70– 79	0
60– 69	0
50– 59	0
40– 49	0
30– 39	6
20– 29	9
10– 19	6
	32

If you compute the median salary received, you will find it to be $30+1/6\times10$ or $31.67. Now if the eleven people receiving $100–109 had received $40–49 instead, this average of $31.67 would still be the same. The mean salary in the first case would be $52.50 and in the second case $31.87. Thus we see that the mean is affected and the median is not. Now if you were the employer—the man who has to pay out the wages—would you want to know the mean or the median salary?

You also notice that when the mean was $52.50 there were 21 of the 32 employees receiving less than this amount. If you were going to apply for a position at this store, which average the mean or the median would indicate best to you the salary that you could expect to receive?

We can state that the value of the mean is affected by extreme cases while the value of the median is not. In the example above it makes no difference as far as the median is concerned where those eleven people are in the distribution as long as they are situated above the interval 30–39. For this reason and also because of the comparatively simple procedure involved, the median is nearly always used for values which test the achievement of a group of students.

There are then some situations in which the mean is more desirable and some in which the median gives you a more reliable average. You should employ the one which gives the fairest interpretation of the data in view of the purpose for which they are to be used.

At this point in the unit a test was given which covered the material that had been presented. A practice test was given the students two days before the date set for the regular test.

After the test had been scored the students were given the frequency distribution of the scores for all three classes and were told to assign grades. The pupils did not know their own scores until after the grades were assigned. They were told to give about 7–10 per cent, A; 12–24 per cent, B; 38–50 per cent, C; 15–24 per cent, D; and 7–10 per cent, F.

It was also pointed out to them that if possible a change from one letter grade to another should occur at a break in the distribution; that is, a score that no pupil obtained. Thus they would be able to eliminate the undesirable situation where 26 might be a D and a score of 25 an F.

This latter statement influenced the assignment of grades to the extent that the students tended to lower the range of C's too far down in the distribution. On changing some of the C's to D's the instructor presented the following argument:—

Two days previous to this test you were given a practice test which was very similar to the regular test. These problems were all explained to you and you were given ample opportunity for special help both in class and out. You were also allowed sufficient time to do your best on the examination. For these reasons it does not seem fair to give a grade of C to a pupil who has less then half of the entire test correct.

This served to show the pupils that there is no hard and fast rule for determining the number of pupils who get A, B, or C.

At the beginning of the Unit the pupils were told to save all the assigned work and to put it into booklet form. This was to be handed in at the end of the unit. The following is a list of items that they were asked to include in their booklets:

1. Frequency distributions for all the tests.
2. Histograms. At least one (Others optional)
3. Means for all tests.
4. Answers to mineographed questions.
5. Medians for all tests.
6. 25th and 75th percentiles for all tests.
7. Cumulative table.
8. Graph comparing means with medians. (Optional)
9. Profile graph.
10. Assigning grades on unit test.
11. Percentile graphs. (Optional)
12. Percentile scores on tests. To be read from percentile graphs circulated around the class.

The idea of percentiles together with

the construction and reading of percentile graphs was introduced as a connecting link between this unit and the one that was to follow.

The deciles for a frequency distribution were figured with the aid of the class and plotted on the blackboard graph chart. This graph was used to translate scores of several of the students into percentile ranks and the meaning was explained to them. As an optional assignment the pupils were allowed to make percentile graphs of their own. The teacher constructed two such graphs and collected four from the pupils. These were circulated around the class and each pupil was given an opportunity to locate his P. R. on the tests and include this in his cumulative table.

The pupil interest and participation were high during the presentation of this unit. The student teachers who were observing remarked that they themselves had a much better understanding of statistics as a result of their experience. The writer does not wish to leave the impression that the above unit has reached perfection. Possible improvements lie in the introduction of more social data and less emphasis on test scores.

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Regional Organizations of Mathematics Teachers

By J. R. Mayor
Southern Illinois State Normal University, Carbondale

If the mathematics teachers will get together in groups to work out common problems, to add to their own and their students' enthusiasm and satisfaction, and to observe and enjoy success of others in a field where the ideals of success and perfection are held high, they will be serving their own interests in many ways. Such groups can contribute much to the improvement of teaching mathematics and the work of such a group will bring the importance of mathematics before the public which is now hearing so much carelessly said about the value of mathematics. The National Council of Teachers of Mathematics is encouraging the organization of regional groups of mathematics teachers, for the field is wide open for regional work in improving the instruction in mathematics and in letting people know of its contribution to their everyday living.

One can scarcely fail to observe the modesty of twentieth century teachers of mathematics. Though this trait may come from a wider knowledge of what it means to prove bold claims and a keener ability to analyze those claims in terms of the relations which they imply, mathematics teachers are much too hesitant to advertise themselves as teachers of democracy and as promoters of the social welfare, or even as promulgators of one of the social sciences.

The athletic coaches display their wares, of course sometimes to their disadvantage; the music teachers have parades and band festivals; the commercial teachers take the boys and girls to at least one speed contest annually; the English teachers review books and judge essay or declamation contests; the social science teachers address the civic clubs; but the mathematics teachers are seldom seen and more rarely heard from. Indeed most of us include this as one of the many advantages of being teachers of mathematics. I have appreciated it.

It was as recently as two years ago that a mathematics teacher dared to suggest at our division meeting of the state teachers association that perhaps the section for principals would be giving less attention to the mathematics teachers if we tried a little more to let others know what we were doing. The rather cautious suggestion proved to be a challenge, and in the short interval of two years, the mathematics teachers of this division have the most active organization of any group of teachers in the region and have put on the best show of any.

At the beginning I shared the misgivings of the most pessimistic. I hope, however, by relating briefly some of the specific accomplishments of this group and by stating briefly an analysis of the work and the possibilities of such an organization, to clear my conscience on this point to help "sell" the idea as completely to others as it has sold itself in our region.

The organization accepted, as two of its primary objectives, the stimulation of interest of the high school students in mathematics, and the presentation to the public of some of the fine work that is being done and can be done in the mathematics classes. A partial realization of these objectives took the form of a Mathematics Field Day to which high school students, teachers, principals, and parents were invited. Over three hundred actively took part in the events of the day. Two teachers told of the thrill that their mathematics students had in engaging the school bus usually reserved for athletic teams, bands, and other extracurricular organizations.

One of the important features of the Field Day was an exhibit to which most of the high schools contributed. This exhibit included displays of work of the mathematics classroom and outside projects of mathematical interest. Space was allowed for an exhibit of recent high school texts and books recommended for high school mathematics libraries.

Students were given an opportunity at the morning and afternoon general sessions of the Field Day to explain briefly their exhibits, work of their clubs, or any project or problem of particular interest. The program of the general sessions also included group singing of songs with mathematical words and the showing of mathematical films.

Competitive tests were given in first semester algebra, plane geometry, solid geometry, third semester algebra, and trigonometry. Those having the ten highest scores on each of these tests received certificates of award and blue ribbons.

Another feature of the day's program was in the form of illustrated lectures on "Dynamic Symmetry" and "Great Men of Mathematics," which were given by two college students for those interested.

The Field Day has now become an annual event. New features include mathematical plays; brief talks by non-mathematicians on the importance of mathematics in their work; awards for projects displayed and explained, including the selection of the best for a more permanent exhibit; and publication of a newspaper with pictures and stories of the Field Day and of other significant mathematical activities.

In addition to sponsoring the Field Day this regional organization has conducted an afternoon conference for the teacher group to discuss the content and the teaching of general mathematics. The group maintains a book club of books of value to the secondary mathematics teacher. Each teacher keeps a book two weeks and then passes it on to another. In the spring after the complete circulation the books are auctioned.

The annual mathematics section meeting of our division of the state teachers association has been greatly improved by a permanent organization of this kind.

With the enthusiasm of this group for stimulus one has no difficulty in formulating a program of activity. The following list could provide the basis for the establishment of a group and a few weeks of organization will bring many more ideas to light, some of which may be peculiar to a particular region, and if so, all the better. The first list entitled "Their Work" includes points which I think any organization of this kind is certain to cover, but which are worth enumerating for those who doubt the existence of such worthwhile group opportunities.

Their Work

A regional organization will

1. Help teachers become better acquainted.
2. Provide opportunity for teachers to hear prominent speakers and thinkers.
3. Make the public aware of a live interest in the teaching of mathematics.
4. Provide a sounding board for good news about mathematics.
5. Create interest among teachers.
6. Promote the interests of the national organization.
7. Keep members up-to-date on teaching methods.
8. Improve sectional meetings at teachers meetings through permanent organization.

In a second group which I have entitled "Their Possibilities" I have included a variety of projects which in my opinion an organization of secondary mathematics teachers might undertake.

Their Possibilities

A regional organization might

1. Provide teacher discussion groups for mutual problems.
2. Make current literature available to members.
3. Prepare course materials, such as non-geometric materials for use in geometry,

materials for general mathematics, materials emphasizing regional uses of mathematics, and tests.
4. Maintain an exhibit.
5. Provide for a testing program to raise standards in the region.
6. Maintain a defense committee to prepare a defense of mathematics appropriate to the region, to file information for use upon call of any school, and to answer criticisms in newspapers and other periodicals.
7. Maintain a permanent committee to study the mathematics curriculum.
8. Organize courses.
9. Conduct experimental studies; for example, studies in course organization, in teaching methods, or in testing.
10. Maintain a clearing house for criticisms of textbooks.
11. Provide for student contacts among schools through competitive or non-competitive recognition, joint meetings, the organization and promotion of a Junior Association similar to the Junior Mathematical Association affiliated with the Mathematical Association (London), and through club visitations.
12. Improve standards of teachers in the region by attracting the best new teachers to the region, by working for higher standards for teachers of mathematics, and by providing an employment bureau.
13. Issue a periodical.
14. Mold the policy of national organizations.
15. Bring an exchange teacher to the region for benefit of all.
16. Start a collection of mathematical interest.
17. Set a pattern for other fields of study.

THE MATHEMATICAL ASSOCIATION OF AMERICA

invites the members of the National Council of Teachers of Mathematics to become members of the Association. The official journal

AMERICAN MATHEMATICAL MONTHLY

is sent to all members on payment of the annual dues of $4.00. Membership application blanks, a sample copy of the MONTHLY, and further information may be obtained on request. The usual initiation fee of $2.00 will be waived for members of the National Council.

W. D. CAIRNS, Secretary-Treasurer

97 Elm Street, Oberlin, Ohio

Please mention the MATHEMATICS TEACHER when answering advertisements

Mathematics Films

By E. H. C. HILDEBRANDT
State Teachers College, Upper Montclair, New Jersey

AT THE present time it is generally assumed that the motion picture film can be used to good advantage in teaching the units in the various school subjects. It is, therefore, natural that the teacher of mathematics is led to inquire regarding films which could be so used in the mathematics classroom. The first source for such information is no doubt the latest edition of the *Educational Film Catalog*.[1] In the 1939 edition only three films were listed under the heading *Mathematics* and one of these, "Visualized Solid Geometry," was withdrawn from circulation early this year. A second source for the teacher may be found in the catalogues published by the various distributors, copies of which are no doubt on file in the office of the principal or the head of the visual aids department of the local school system. Over half of the state universities have established extension divisions for the distribution of these films and a list of these is found in the *Educational Film Catalog* as well as at the close of this article. In addition there are a number of private distributors with offices in many of the principal cities.

While the number of films dealing directly with mathematics is small, we hope that more and better films may be produced in the next few years. This will will come about only if the cooperation of every teacher interested in such films may be secured. Such helpful interest may be manifested in the following ways:

1. Suggest improvements that could be made in the film as related to your own classroom experiences.

2. Recommend topics for other films which you feel would be of benefit to you in your teaching.

3. If possible, suggest subject material to be used in such films.

4. Send these criticisms, suggestions and recommendations to the Chairman of the Committee on Visual Aids of the National Council of Teachers of Mathematics.[2]

In the list of films appearing below, an attempt has been made to list the more important films relating to mathematics the teaching of mathematics, and the applications of mathematics in various subject matter fields as well as in commerce, industry and the community. It should however be pointed out that:

1. The list is by no means complete. Teachers finding additional titles useful in their work should call these to the attention of the Committee as soon as possible.

2. The list of distributors is not all-inclusive.

3. Rental prices are approximately the same with all distributors. However, in many cases, lower rents are charged users in the same state or schools paying a special registration fee at the beginning of the school year. Special quantity rates are sometimes quoted. Catalogs should be consulted for this information.

4. In general, transportation charges (usually express) are paid both ways by the user.

5. Reservations should be made as early in the school year and as far in advance of the date for showing, as possible.

6. Most films are 16 millimeter size although a few are available in 35 millimeter.

7. Abbreviations are readily interpreted. The names of distributors and producers will be found at the close of this list.

This list is a revision of one published in

[1] *Educational Film Catalog* compiled by Dorothy E. Cook and Eva Rahbek-Smith, H. W. Wilson Company, New York, 1939.

[2] Address the author at State Teachers College, Upper Montclair, New Jersey.

the *American Mathematical Monthly*[3] and another which appeared in mimeographed form in March 1940 and distributed at the meeting of the Association of Mathematics Teachers of New Jersey. The author wishes to express at this time his appreciation to Dr. Lili Heimers, Director of Visual Aids, Montclair State Teachers College, for her cooperation in calling a number of the titles and distributors to his attention.

Geometry

Circles

An eighth grade class is shown making a study of circles from things they see every day. This film may be used in junior high school and in teacher training classes to illustrate how this unit may be introduced to a class.
1 reel, 16 mm., silent, 400 feet, 20 min.
Rent: $1.00, Miss Claribel E. Bruce, principal, No. 52 School, 100 Farmington Road, Rochester, New York.

Geometry

This film was made under the direction of Charles H. Sampson, headmaster, Huntington School for Boys, Boston. A knowledge of the subject is built up from the very beginning of plane geometry and is carried through the solid geometry. The various plane figures are illustrated and their properties developed. Solids are built up by the use of plane figures. Practical applications of geometry are noted throughout the film. 2 reels, 16 mm., silent, 25 min.
Rent: $4.00 per day for two reels, WFS.
Sale: $50.00, WFS.

Geometry in Action

Introduces the student to geometrical forms and figures as found in the hexagonal honeycomb, cylindrical oil tanks, skyscrapers, symmetry of a dress pattern, parallel lines of oars in a crew race, suspension bridges and transportation on land, sea and air. Produced by David Reichgott and Lee Spiller, this is the first in the "Geometry Brought to Life" series. Other films are planned for release by the producer at the rate of one every two months after September 1, 1940.
1 reel, 16 mm., sound, 1940.
Rent: $1.50 VES (for other distributors, write the producer).
Sale: $30.00 per reel for three school-year lease.—the producer: Bald Eagle Film Productions, 104 Howe Street-Annex, New Haven, Connecticut.

How Our Eyes Deceive Us

A few of the more common optical illusions involving lengths of lines, parallel lines, circles. Many of the illusions are produced by the kaleidoscope. This or a similar film may be found on some distributors' lists under the title "Kaleidoscope" or "Through the Kaleidoscope."
¼ reel, 16 mm., silent.
Rent: $0.10–0.75, A+B, BY, Col, Minn, Tex.

Introduction to Mechanical Drawing

Correct use of ruler, compass and other instruments is shown as well as drawings made of articles requiring one, two and three views.
1 reel, 16 mm., silent, 20 min., 1932.
Rent: $0.75–1.00, Col, Wis.

Rectilinear Coordinates (Knowledge Builders Series)

This is the first of a series of films dealing with plane, solid and analytic geometry. Animation is used throughout to develop the two and three dimensional coordinate systems. Descartes' Theorem, point, line, plane and solid, number scale, co-ordinates, axes, and three dimensional locations and relationships are explained by the producer, John H. Lewis.
1 reel, 16 mm., sound, 12 min., 1939.
Rent: $1.50–2.00, B+H, Cal, CFC, Ill, Kan, KB.
Sale: $36.00, B+H, KB.

Advanced Mathematics

Frequency Curves

Explains nature of statistical frequency distribution and depicts reason frequency curves must be considered as boundaries of an area. Illustrates fact that properties of a group of natural objects must usually be expressed as a frequency distribution.
½ reel, 16 mm., silent, 8 min.
Rent: $1.00, Buck, Wis.
Sale: $12.00, EK.

The Isograph

Shows the instrument developed and used in the Bell Telephone Laboratories for finding quickly and easily the real or

[3] "Slides and Films Relating to Mathematics and its Applications," Hildebrandt, E. H. C., *The American Mathematical Monthly*, XLV. October 1938, pp. 548–50.

complex roots of a polynomial. Dr. Fry, the designer of this instrument, is shown solving one such polynomial by means of this machine. Particularly interesting to teachers, engineers, and college students of mathematics, physics and engineering who are prepared in calculus, theory of equations and theory of functions of a complex variable.
1 reel, 16 mm., silent, 1938.
Loaned free: Apply Miss L. E. Smith, Librarian, Bell Telephone Laboratories, 463 West Street, New York City.

Parabola (see description under *Mathematics and Art*)

Teaching of Mathematics

Individual Differences in Arithmetic

Dr. G. T. Buswell of the University of Chicago demonstrates an elaborate machine which photographs the eye movements of a child in adding figures, another machine which records the rhythm of a pupil's adding and finally a diagnosis to aid pupils in mastery of the subject.
2 reels, 16 and 35 mm., sound, 20 min.
Sale: 16 mm. $85.00. 35 mm. $190.00, Erpi.

Circles (see description under *Geometry*)

Mathematics and Art

Modes and Motors

This picture shows the seven elementary shapes of artistic design, namely the straight line, the semi-circle, the circle, the spiral, the wave line, the broken line and the letter S. It shows that while these fundamentals were existent some fifty thousand years ago, they still serve to guide modern-day artists in present day design. The picture takes you behind the scenes in the Art and Color section of General Motors where it portrays the artists and technicians conceiving and designing tomorrow's products for large industrial manufacture.
1 reel, 16 mm., sound, 10 min., 1939.
Loaned free: GM, YMCA.

Parabola

Possible uses of the parabola in the field of design and architecture are presented by the author, Mr. Rutherford Boyd. A large collection of designs and parabolic forms was used in producing this film. Synchronized to Milhaud's Ballet Suite "La Creation du Monde." Designed and produced by Mary E. Bute, Theodore J. Nemeth and Rutherford Boyd.
1 reel, 16 mm. and 35 mm., sound, 9½ min., 1938.
Rent and sale: Apply Mr. Rutherford Boyd, 112 Prospect St., Leonia, New Jersey.

Rhythm in Light (Abstract Film Service)

Cones, spirals, spheres and other geometrical forms are used to develop themes in design. Synchronized to Grieg's Anitra's Dance. Designed and produced by Mary E. Bute, Melville Webber, Theodore J. Nemeth.
1 reel, 16 and 35 mm., sound, 7 min., 1938
Rent: $2.00, CFC.
Sale: $35.00 Expanding Cinema, 422 W. 46th St., New York City.

Synchromy No. 2 (Abstract Film Service)

Three dimensional forms and patterns separate and reunite to form designs and figures.
1 reel, 16 and 35 mm., sound, 1938.
Rent: Expanding Cinema (see above).
Sale: $35.00, Expanding Cinema.

Teaching Creative Design

Taking a cut paper square of one inch on a side, a junior high school art teacher demonstrates in her class how to design decorative borders and how to interpret forms taken from nature. Pupils are taught to understand form and structure of the design.
1 reel, 16 mm., silent, 15 min. 1939.
Rent: $1.50, Harmon, SC, YMCA.

We Are All Artists

A simple analysis of design as it applies to the work of the great masters as well as to the common objects that surround us.
3 reels, 16 mm. silent, 45 min. 1935.
Rent: $4.50 Harmon, Cal, VES, YMCA.

Mathematics and Architecture

Churches and Cathedrals (No. 1) (Our World in Review Series)

Compares three of the most beautiful Gothic churches in the world: Chartres, the oldest, with its stained glass windows, Notre Dame in Paris with its grotesque sculpture, and the Riverside Church in New York City. Closeups of buttresses, towers and portals are shown.
1 reel, 16 mm., sound, 10 min., 1937.
Rent: $1.50, B+H, Gut, Mich, NC, Tex, VES, YMCA.
Sale: $36.00, Gut, VES.

Churches and Cathedrals (No. 2) (Our World in Review Series)

The Cathedral of Santo Domingo, still believed to be the eternal resting place of Christopher Columbus, historic Spanish missions of Texas and a modern adaptation of Byzantine architecture—the Temple Emanuel in New York City.
1 reel, 16 mm., sound, 10 min., 1937.
Rent: $1.50, B+H, Gut, NC, VES, YMCA.
Sale: $36.00, Gut, VES.

For All Eternity

A survey of England's cathedrals showing their significance in English history as well as their essential beauty in the English landscape.
2 reels, 16 mm., sound.
Loaned free: YMCA.

Mathematics and Nature

Mysteries of Snow

An analysis of snowflakes in drawings and photomicrographs.
⅔ reel, 16 mm., silent.
Rent: $0.50–1.25, Bray, CFC, EPS, FI, Mo, NH, VES.
Sale: $13.08, Bray, FI, VES.

Dewfall—Nature's Jewel

Shows specimens of dew condensation and frost formation under the microscope, from photographs made by the late A. W. Bentley, author of "*Snow Crystals.*"
¼ reel, 16 mm., silent.
Rent: $1.00, Bray, FI, Wis.
Sale: $5.40, Bray, FI.

Crystallization

The microscope shows the formation of crystals in the forms of icicles and snow flakes. Shown also are crystals of quartz, amethyst and salt, how crystals may be formed and factors determining their shape.
2 reels, 16 mm., silent, 20 min.
Rent: $1.50–2.50, Bray, Cal, FI, Minn, VES.
Sale: $41.16, Bray, FI, VES.

Weights and Measures

Getting Your Money's Worth

Exposes frauds and misrepresentation practiced by unethical manufacturers in the sale of food, clothing and other commodities.
1 reel, 16 and 35 mm., sound, 11 min., 1937.
Rent: 16 mm., $1.00–1.50, CFC, Kan, Wis.

Precisely So

Deals with the history and development from ancient times of modern standards of accuracy in measure. Newest scientific instruments are shown measuring time to the thousandth part of a second, weighing a dot of a lead pencil on a sheet of paper, splitting a hairbreadth measurement into hundreds of parts.
1 reel, 35 mm., sound, 20 min.
Loaned free by Chevrolet Motor Divison, General Motors Sales Division, Detroit, Mich. (apply to your local Chevrolet dealer).

Protecting the Consumer (March of Time)

Tricks of the short weight and short measure cheat are exposed. It shows inspectors locating merchants using false scales. Such old tricks as weighing turkey with lead, the short yardstick, labels with some figures in very small type, eye-deceiving over-sized boxes and false bottomed cans, are exposed.
½ reel, 16 mm., sound, 5 min., 1938.
Rent: $1.00–2.00, Ga, Ill, Mich, Minn, Wis.
Sale: $40.00, Association of School Film Libraries, 9 Rockefeller Plaza, New York City.

Science Rules the Rouge

The importance of the laboratory in modern transportation is shown. Part of the film shows how measurements are made which are accurate to a millionth of an inch.
1 reel, 16 and 35 mm., sound, 21 min., 1939.
Rent: 16 mm. Kan. Also apply to local Ford dealer.

When You Can Measure

Explains the use of electric measuring instruments and the development of modern types, the accuracy of manufacture of parts and their precision asssembly.
Loaned free: Apply General Electric Company.

Money, Finance, Social Security

Know Your Money

Deals chiefly with the difference between spurious and real coins and currency, showing closeups of various denominations and the imperfections to be detected in a counterfeit engraving. Lowell Thomas acts as commentator in this film produced by the U. S. Treasury Department. Copies of a pamphlet "Know Your

Money" are also available in any quantity desired.
1 reel, 16 mm., sound, 19 min., 1940.
Loaned free: Apply Mr. Fred W. Gruber, Supervising Agent, Treasury Department, United States Secret Service, Newark, N. J. for address of district office nearest you.

Making Money—The Canadian Mint (or *A Money Making Industry*)

Shows how Canada mints its coinage.
1 reel, 16 mm., silent.
Rent: $0.25–1.50, Col, Ill, Ky, Mo, Okla, Syr.
Loaned free: NJ, YMCA.

Royal Mint

A picture of the Canadian mint.
1 reel, 16 mm., sound.
Loaned free: YMCA.

Big Money

Shows the machinery of British Post Office finance. The Post Office is one of the largest trading concerns in the world.
2 reels, 16 mm., sound.
Loaned free: YMCA.

Our Children's Money

Difficulties of a family due to poor financial planning lead to a discussion of the need for a systematic plan. A budget for saving, giving and spending is set up and carried out.
2 reels, 16 mm., silent, 15 min.
Rent: $3.00, Harmon, NC, SC, YMCA.

Now for Tomorrow

Against the daily background of the public health nurse, it shows the importance of putting up a security fund for old age.
3 reels, 16 mm., silent, 1935.
Rent: $3.00, Harmon, YMCA.

Ann Faces the Future

Shorter version of *Now for Tomorrow.*
1 reel, 16 mm., silent.
Rent: $1.50, Harmon, YMCA.

The Workers' Old-Age and Survivors Insurance Account

Describes the procedures involved in setting up and maintaining Workers' Old-Age and Survivors Insurance accounts. Suitable for senior high school and college use.
2 reels, 632 feet, 16 mm., sound, 20 min., 1940.

Social Security Benefits

Dramatizes the processes involved in filing a claim and receiving payments under the Old-Age and Survivors Insurance law.
2 reels, 16 mm., sound, 614 feet, 20 min., 1940.

Both of the above films may be purchased for $15.00 each, including study material, from DeLuxe Laboratories in New York City after obtaining prior authorization from Informational Service, Social Security Board, Washington, D. C. Single showings may also be arranged, without cost, through regional Informational Service representatives of the Board.

The Lord Helps Those—Who Help each Other

A study of the Cooperative Movement in Nova Scotia, it shows producer and consumer problems and the credit union and cooperative store in action.
3 reels, 16 mm., silent, 40 min., 1938.
Rent: $4.50, Harmon, SC, YMCA.

Oh Say Can You See (American Progress Series)

Deals with the subject of taxes.
1 reel, 16 and 35 mm., sound, 1939.
Rent: American Films Foundation, Inc.
Sale: 16 mm. $15.00, 35 mm. $30.00. American Films Foundation, Inc., 542 Fifth Avenue, New York City.

Mathematics and Physics

Einstein's Theory of Relativity

An introduction to the relativity of speed, time, size, motion and measurements.
2 reels, 16 mm., silent, 30 min., 1924.
Rent: $1.50–2.00, A+B, B+H, CFC, Ky, VES, Wis.

Behavior of Light

Formation of images in plane, convex and concave mirrors as well as the transmission of light and the causes of shadows, eclipses and refraction.
1 reel, 16 mm., silent, 15 min., 1930.
Rent: $0.75–1.50, A+B, Ariz, Buck, BY, Cal, Col, Ga, IaS, Ill, Kan, Ky, Mich Mill, Minn, Mo, NJ, Syr, VES, Wis.
Sale: $24.00, EK, VES.

Eyes of Science

The story of the telescope and microscope, it pictures Galileo with his early

telescope, Leeuwenhoek with his simple microscope, and shows the arrangement of lenses and tubes resulting in the modern telescope. Also the spectroscope, ophthalmoscope, binoculars and motion picture machines.
3 reels, 16 and 35 mm., silent, 45 min.
Rent: $0.50–1.00 per reel, Cal, Col, Ga, Kan, NJ (free).

Lenses

Emphasizes lens refraction, action of converging and diverging lenses, formation of real and virtual images, construction and explanation of achromatic lenses.
1 reel, 16 mm., silent, 15 min., 1931.
Rent: $0.75–1.50, A+B, AM, Ariz, Buck, IaS, Ill, Ind, Ky, Mich, Mill, Minn, Syr, VES, Wis.
Sale: $24.00, EK, VES.

Light Waves and Their Uses

Explains in an elementary fashion the principles of refraction and reflection with plane, concave and convex mirrors. Leads to an introduction to quantum theory.
1 reel, 16 mm., sound, 11 min., 1937.
Rent: $1.00–2.00, AM, BY, Cal, CFC, Ga, Ia, IaS, Ill, Ind, Kan, Ky, Mich, Minn, Mo, NC, Okla, SC, Syr, WashCE Wis.
Sale: $45.00, Erpi, Twy.

Optical Instruments

Applies the principles of reflection and refraction to mirrors, spectacle lenses, the camera, stereopticon and moving picture projectors, microscopes and telescopes.
1 reel, 16 mm., silent, 15 min., 1931.
Rent: $0.75–1.50, A+B, Ariz, Buck, By, Ill, Ind, Ky, Mich, Mill, Minn, Syr, Wis.
Sale: $24.00, EK.

Sound Waves and Their Sources (Univ. of Chicago Physical Science Series)

The high-speed camera, animation, sound effects and an oscilloscope are used in demonstrating the characteristics of sound waves, i.e. frequency, amplitude, wave length, fundamentals and harmonics.
1 reel, 16 mm., sound, 11 min., 1933.
Rent: $1.00–2.00, A+B, AM, Ariz, B+H, BY, Cal, CFC, Col, EPS, Ga, Ia, IaS, Ill, Ind, Kan, Ky, Mill, Minn, Mo, NC, NH, Okla, PCW, SC, Tex, VES, WashCE, Wis.
Sale: $45.00, Erpi, Twy, VES.

Vibratory Motions and Waves

Uses slow motion photograph and animation to show simple harmonic motion resulting from the tuning fork, damped, undamped, stationary and propagating waves. Also wave length, phase, crest, trough, nodes, antinodes, condensation and rarefaction, transverse and longitudinal waves.
2 reels, 16 mm., sound, 20 min.
Rent: $3.50–4.00, EPS, FI.
Sale: $75.00, EPS, FI.

Simple Machines

Beginning with the lever, it introduces the principles underlying the six simple machines and shows the principles of operation of these machines in combination in complex machines.
1 reel, 16 mm., silent, 15 min., 1929.
Rent: $0.50–1.50, A+B, Ariz, Buck, BY, Col, Ga, Ia, IaS, Ill, Ind, Kan, Ky, Mich, Mill, Minn, Mo, NH, PCW, Syr, VES, Wis.
Sale: $24.00, EK, VES.

Engineering and Industry

Bridges

Old fashioned drawbridge; bridges in Venice, Paris, Holland, the famous Tower bridge in London, the bridge in Florence where Dante met Beatrice; the Bridge of Sighs in Venice, old bridges in Carthage and in Greece. The Royal Bridge of China, rope bridge in the West Indies, Cable bridge in Italy. Holland Tunnel, Brooklyn Bridge and Golden Gate Bridge.
1 reel, 16 mm., silent.
Rent: $0.50–0.75, A+B.

Construction of the George Washington Bridge

Non-technical, animated photography, some scenes in color. Explains the structural principle of the suspension bridge, cable spinning and principal steps in construction.
1 reel, 16 mm., silent, 10 min., 1938.
Loaned free to New York City and New Jersey schools, NJ, PNYA.
Rent: $1.50, PNYA.
Sale: $30.00, PNYA.

Conquest of the Hudson—The Story of the Lincoln Tunnel

Dramatizing, planning, construction and operation of newest Hudson River crossing. Highly technical.
2 reels, 16 mm., sound or silent, 35 mm. sound, 20 min.

Loaned free to New York City and New Jersey schools, NJ, PNYA.
Rent: $2.50, PNYA.

The Engineer

It shows the school training necessary and the steps through which one must pass to qualify as chief engineer; the construction of the Brooklyn Bridge and the East River Tunnel from preliminary plans to the completed structure.
1 reel, 16 mm., silent.
Rent: $1.50, A+B, EPS, NJ (free).
Sale: $24.00, EPS.

The Skilled Mechanic

What the skilled mechanic actually does at work. (Film is outdated and has been withdrawn by many distributors.)
1 reel, 16 mm., silent.
Rent: $1.50, EPS, VES.
Sale: $24.00, EPS.

Development of Transportation

Changes in transportation in the United States in the past hundred and fifty years include the spread of the railroads, development of the automobile and airplane.
1 reel, 16 and 35 mm., sound, 10 min. 1939
Rent: $1.50–2.00, AM, BY, Cal, Geo, Ill, Ia, Kan, NH, SC, Syr, Wis, YMCA.
Sale: $45.00, Erpi, Twy.

Transportation

Traces man's effort to overcome time and distance forces greater than his own, from primitive to modern times.
1 reel, 16 mm., silent, 15 min., 1926.
Rent: $0.50–1.50, A+B, Bray, Ind, NJ, Wis.
Sale: $24.00, Bray, B+H, FI.

Velocity

Considers the degree of speed of snail vs. race horse, wagon vs. airplane, glacier vs. comet.
1 reel, 16 mm., silent.
Rent: $0.50–0.75, A+B.

The following films on transportation are loaned free by the General Electric Company;

The Conquest of the Cascades (silent and sound, 16 and 35 mm.)
The Broken Barrier (sound, 16 and 35 mm.)
The King of the Rails (silent, 16 and 35 mm.)
Queen of the Waves (silent, 16 and 35 mm.)
The Panama Canal (silent, 16 and 35 mm.)
Modern Electric Transit (sound, 16 and 35 mm.)

Further information regarding the following related films may be found in the Educational Film Catalog

Boulder Dam
Norris Dam
Grand Coulee Dam
Challenge of the TVA
Roosevelt Dam
TVA
Millions for Safety (Constructing the Lincoln and Holland Tunnels)

MATHEMATICS AND ASTRONOMY

Communing with the Heavens (Seeing Canada Series)

Trip through the Dominion Observatory at Ottawa, Canada. Shows the sundial, reflectors at work, the seismograph, observations for correct time and the taking of telescopic photographs.
1 reel, 16 mm., silent, 13 min.
Rent: $0.35–1.50, A+B, AM, Cal, Ill, Ky, Mo.
Loaned free: NJ, YMCA.

Development of Astronomical Knowledge

A historical treatment of the growth of astronomy from the time of the Chaldeans, through the works of Copernicus, Kepler, and Galileo. Included also is a diagrammatic explanation of Ptolemy's Theory of Epicycles and detailed illustrations of various discoveries.
1 reel, 16 mm., silent.
Rent: $1.00–1.50, EPS, Ky, VES, Wis.

The Earth in Motion (Univ. of Chicago Physical Science Series)

Demonstrates the sphericity of the earth, its rotation as established by star trails and the Foucault pendulum, its revolution about the sun, characteristics of orbit, law of areas, the inclination of axis, summer and winter solstice, autumnal and vernal equinox, temperate zones, the seasons.
1 reel, 16 and 35 mm., sound, 11 min., 1936.
Rent: $1.00–2.00, AM, Ariz, BY, Cal, CFC, Ga, Ia, Mich, Mill, Minn, Mo, NC, Okla, PCW, SC, Syr, WashCE, Wis.
Sale: $45.00, Erpi.

The Earth—Latitude and Longitude

The hemispheres, latitude and longitude and the reckoning of time, the exact loca-

tion of a position on the earth's surface as demonstrated by locating a ship in distress at sea.
1 reel, 16 mm., silent or sound, 12 min.
Rent: $1.50–2.00, CFC, EP, FI, VES.
Sale: $25.00–35.00, EPS, FI.

Exploring the Universe

Explains the principles and construction of refracting and reflecting telesopes and how they are used in studying the aspects of the stars within our galaxy and of the galaxies themselves. Shown by means of animated drawings are the transformation of the dipper during the next hundred thousand years, binary stars, eclipsing variables, trinary stars, apparent star motion due to motion of the solar system, galactic rotation and the portrayal of the theory of the expanding universe.
1 reel, 16 and 35 mm., sound, 10 min., 1937.
Rent: 16 mm., $1.00–2.00, Ga, Ia, IaS, Ill, Kan, Mich, Mill, Minn, PCW, SC, VES, WashCE, Wis.
Sale: 16 mm., $45.00, Erpi, Twy, VES.

Gravitation—The Moon—Constellations

Newton is shown working on his Law of Gravitation. Many diagrams are used to explain his theory and its application to calculating the orbits of the planets. Phases of the moon and the constellations of the Big and Little Dipper, Cassiopeia, Lyra, Perseus and Auriga are also shown.
1 reel, 16 mm., silent.
Rent: $1.00–2.00, EPS, Minn, PCW.

The Solar Family (Univ. of Chicago Physical Science Series)

Pictures in animation, the revolution of the planets in their orbits about the sun. Suggests possible origin of the solar system and movements of the solar system in space. Also seen are Halley's comet and the nebulae.
1 reel, 16 and 35 mm., sound 10 min., 1936.
Rent: 16 mm., $1.00–2.00, AM, BY, Cal, EPS, Ga, Ill, Ia, Kan, Ky, Mich, Minn, Mo, NC, Okla, PCW, SC, Syr, Wis.
Sale: 16 mm., $45.00, Erpi, Twy.

Telescope Making in the West Allis, Wisconsin, High School

High school students are shown making a four-inch reflecting telescope. This instrument is used to observe the moon, the planets, star clusters and nebulae. Twelfth magnitude stars are located by the skilled observer with one of these instruments, which has been made at a cost of a dollar and a quarter.
1 reel, 16 mm., silent.
Rent: $0.75, Wis.

Through Galileo's Telescope and Mount Wilson Observatory (Our World in Review Series)

The contrast of Galileo using the optic tube invented by a Dutch spectacle maker and observing the movements of Jupiter and Venus, and the one hundred-inch Hooker reflector which magnified the power of the eye 160,000 times. Included is a dramatization of the trial of Galileo for heresy and his final defiance "And yet it moves."
1 reel, 16 mm., sound, 10 min., 1937.
Rent: $1.00–1.50, Gut, Minn, NC, Tex, VES, YMCA.
Sale: $36.00, Gut, VES.

Miscellaneous

Alice in Wonderland

5 reels, 16 and 35 mm., silent.
Rent: 16 mm., $7.50 per day. WFS.

Discontinued Films

The following titles have been discontinued by most distributors:
Becoming Somebody
Definition of Plane Geometry
Elgin Presents Time
Federal Reserve System
The Metric System
Modern Banking
Nation's Market Place
Play of Imagination in Geometry
Visualized Solid Geometry

Producers and Distributors

A+B	Akin and Bagshaw, Inc., 1425 Williams St., Denver, Col.
AM	American Museum of Natural History, 77th St. and Central Park West, New York City
Ariz	University of Arizona, University Extension Division, Tucson, Ariz.
B+H	Bell and Howell Company, 1801–1815 Larchmont Ave., Chicago, Ill., 30 Rockefeller Plaza, New York City; 716 N. LaBrea Ave., Hollywood, Cal.
Bray	Bray Pictures Corporation, 729 Seventh Ave., New York City
Buck	Bucknell University, Classroom Film Library, Lewisburg, Pa.

BY Brigham Young University, Bureau of Visual Instruction, Provo, Utah

Cal University of California Extension Division, Berkeley, Cal., Los Angeles, Cal.

CFC College Film Center, 59 E. Van Buren St., Chicago, Ill.

Col University of Colorado, Bureau of Visual Instruction, Boulder, Col.

EK Eastman Kodak Company, Teaching Films Division, Rochester, New York

EPS *Edited* Pictures System, Inc., 330 W. 42nd St., New York City

Erpi *Erpi* Classroom Films, Inc., 35–11 Thirty Fifth Av., Long Island City, N. Y.

FI Films, Inc., 330 W. 42nd St., New York City; 64 East Lake St., Chicago, Ill.; 314 SW Ninth Ave., Portland, Ore.

Ga University of Georgia, Division of General Extension, 223 Walton St. N.W., Atlanta, Ga.

GE General Electric Company, Visual Instruction Section, Publicity Department, 1 River Road, Schenectady, N. Y.

GM General Motors Corporation, Broadway at 57th St., New York City

Gut Walter O. Gutlohn, Inc., 35 W. 45th St., New York City

Harmon Harmon Foundation, Inc., 140 Nassau St., New York City

Ia University of Iowa, Department of Visual Instruction, Iowa City, Iowa

IaS Iowa State College of Agriculture and Mechanic Arts, Visual Instruction Service, Ames, Iowa

Ill University of Illinois, Visual Aids Service, 113 University High School, Urbana, Illinois

Ind Indiana University, Extension Division, Bloomington, Indiana

Kan University of Kansas, Bureau of Visual Instruction, Lawrence, Kansas

KB Knowledge Builders (McCrory Studios), 130 W. 46th St., New York City

Ky University of Kentucky, Department of Visual Instruction, Lexington, Kentucky

Mich University of Michigan, Extension Service, Ann Arbor, Mich.

Mill Millersville Film Library, State Teachers College, Millersville, Pennsylvania

Minn University of Minnesota, Bureau of Visual Instruction, Minneapolis, Minnesota

Mo University of Missouri, Visual Education Service, Columbia, Missouri

NC University of North Carolina, Extension Division, Chapel Hill, North Carolina

NH University of New Hampshire, Extension Division, Durham, New Hampshire

NJ New Jersey State Museum, Trenton, New Jersey. (Loans in New Jersey only)

Okla University of Oklahoma, Bureau of Visual Education, Norman, Oklahoma

PCW Pennsylvania College for Women, Pittsburgh, Pennsylvania

PNYA Port of New York Authority, Department B, 111 8th Ave., New York City

SC University of South Carolina, Audio-Visual Aids Service, Columbia, South Carolina

Syr Syracuse University, Cooperative Educational Film Library, Syracuse, N. Y.

Tex University of Texas, Visual Instruction Bureau, Austin, Texas

Twy Alan B. Twyman Sound Film Libraries, Inc., 29 Central Ave., Dayton, Ohio

VES Visual Education Service, 131 Clarendon St., Boston, Mass.

WashCE Central Washington College of Education, Ellensburg, Wash.

WFS Wholesome Film Service, Inc., 48 Melrose St., Boston, Mass.

Wis University of Wisconsin, Bureau of Visual Instruction, Madison, Wisconsin

YMCA National Council of Young Men's Christian Associations, Motion Picture Bureau, 347 Madison Ave., New York City; 19 S. LaSalle St., Chicago, Illinois; 351 Turk St., San Francisco, California

EDITORIALS

Mary Kelly's Retirement

ALL MEMBERS of the National Council of Teachers of Mathematics will be interested to know a little more about Miss Mary Kelly, who recently retired from many years of active service in the affairs of the Council and in the Wichita Kansas Public Schools.

Miss Kelly went to Kansas as a child from Kentucky. She was educated in the Wichita Public Schools and in the City Normal School there. She later took an A.B. degree at Friends University, studied in Milwaukee, The University of Chicago, The University of California, and at Teachers College, Columbia University, from which she obtained the M.A. degree.

Miss Kelly taught in the first primary of the Park School in Wichita, later did grade school work, and finally started teaching in the Wichita High School, where she was made head of the mathematics department. As head of the department and as a leader in her city Miss Kelly has been instrumental in bringing prominent men in the field of mathematics to Wichita, and in general, has been responsible, along with some of her strong supporters, for the fine spirit and modern tendencies in the Wichita Schools.

Miss Kelly has been Vice-President of the National Council of Teachers of Mathematics, and is personally responsible for the Wichita Chapter of the Council. She has also been a staff editor of the Kansas State Mathematics Bulletin.

The Mathematics Teacher joins with the membership of the Council in wishing Miss Kelly many more happy years of service, even though not actively engaged.

W. D. R.

Membership in the National Council

THERE is still some uncertainty even among teachers of mathematics to say nothing of those outside the field as to what membership in The National Council of Teachers of Mathematics entitles them.

In the first place anyone (individual, library, or club) can become a full-fledged member of The National Council with all the privileges pertaining thereto by paying the annual dues of $2. Secondly, membership in the Council automatically entitles one to receive the official journal of the National Council, THE MATHEMATICS TEACHER, eight times each year January to December inclusive except that no issues are published in June, July, August, and September. Conversely, anyone who subscribes to THE MATHEMATICS TEACHER for one year and pays the subscription price of $2 automatically becomes a member of the Council.

No membership tickets are issued as all the meetings of the Council are open meetings. It is hoped that more teachers will take out individual memberships so as to help the Council by that much support. Anyone who gives even small financial support to any organization is thereby a little more interested in its welfare.

W. D. R.

IN OTHER PERIODICALS

By NATHAN LAZAR
The Bronx High School of Science, New York City

The American Mathematical Monthly

April, 1940, Vol. 47, No. 4.

1. Kershner, Richard, "Note on Compound Interest," pp. 196–198.
2. McCulley, W. S., "Note on Criteria of Divisibility," pp. 223–225.
3. Hildebrandt, E. H. C., "Mathematical Games, Stunts, and Recreations," pp. 236–239.

National Mathematical Magazine

May, 1940, Vol. 14, No. 8.

1. Bell, Clifford, "The Solution of Numerical Equations," pp. 435–438.
2. Finkel, Benjamin F., "A History of American Mathematical Journals," pp. 461–468.
3. Olds, Edwin G., "We Discover the Meaning of Curvature," pp. 469–471.
4. Little, Neil, "The Drawing of Quadric Surfaces," pp. 472–476.

School Science and Mathematics

November, 1940, Vol. 40, No. 8.

1. Gingery, W. G., "Are Beginning Teachers of High School Mathematics Adequately Trained?" pp. 703–707.
2. Paquet, V. H., "Trisection of an Arbitrary Angle," p. 707.
3. Shea, John J., "Mr. Chips Teaches Geometry," pp. 720–726.
4. Badger, Blanche Crisp, "The Effect of Correlation and Fusion on Geometry Instruction," pp. 749–757.
5. Struyk, Adrian, "The Quadratic Equation," pp. 760–762.
6. Glazier, Harriet E., "Resourcefulness in Teaching the New Arithmetic," pp. 777–779.
7. Read, Cecil B., "The Effect of Scale in Rotation of Axes," p. 800.

Scripta Mathematica

October, 1939, Vol. 6, No. 3.

1. Karpinski, Louis C., "The Origin of the Mathematics as Taught to Freshmen," pp. 133–140.
2. Ettlinger, H. J, "Some Mathematical Aspects of Motion and Causality," pp. 141–148.
3. Franklin, Philip, "The Four Color Problem," pp. 149–156.
4. Mendelsohn, Charles J., "Cardan on Cryptography," pp. 157–168.
5. McCoy, John Calvin, "The Anatomy of Magic Squares," pp. 175–178.
6. Curiosa, pp. 179–180.

Miscellaneous

1. Armstrong, G. F., "Right Start in Analytic Geometry," *School (Secondary Edition)*, 29: 62–65, September, 1940.
2. Becker, A. L., "Remedial Work in the Addition of Common Fractions," *California Journal of Elementary Education*, 9: 43–47, August, 1940.
3. Bell, E. T., "Buddha's Advice to Students and Teachers of Mathematics," *Texas Outlook*, 24: 7-12, September, 1940.
4. Berglund-Gray, G., and Young R. V., "Effect of Process Sequence on the Interpretation of Two-Step Problems in Arithmetic," *Journal of Educational Research*, 34: 21–29, September, 1940.
5. Brueckner, L. J., "Development of Readiness Tests in Arithmetic," *Journal of Educational Research*, 34: 15–20, September, 1940.
6. Cleaveland, B. B., "Number Seat Work," *American Childhood*," 26: 31, September, 1940; 26: 25, October, 1940.
7. Dickeman, F. A., "High School Mathematics and the Eighty Per cent," *American School Board Journal*, 101: 41–42, September, 1940.
8. Frison, C. G., "Common Fractions; Aids in Solving Difficult Problems," *Grade Teacher*, 58: 56+, October, 1940.
9. Gardner, M., "First Grade Learns Linear Measure," *Instructor*, 49: 20, October, 1940.
10. Hoskins, H. S., and others, "Enrichment in Mathematics," *Baltimore Bulletin of Education*, 18: 68–76, September, 1940.
11. Hunter, N., "Multiplication Table Streamlined," *Ohio Schools*, 18: 324–325, September, 1940.
12. Nelson, A. E., "Call the Doctor; Mathematics, Grades V to VIII," *School (Elementary Edition)*, 29: 28–31, September, 1940.
13. Orleans, J. S., and Saxe, E., "How Much Commercial Arithmetic Do Students in a Collegiate School of Business Know?" *Journal of Business Education*, 16: 14–16, September, 1940.
14. Rosenberg, R. R., "Inventory Test in Arithmetic Fundamentals," *Business Education World*, 21: 66–67, September, 1940.
15. Rue, F. C., "Hallowe'en Number Work," *American Childhood*, 26: 23, October, 1940.
16. Tessin, L. D., "Number Seat Work," *American Childhood*, 26: 30, September, 1940; 26: 24, October, 1940.

NEWS NOTES

The Mathematics Section of the Colorado Education Association met in Denver on October 24th. After a luncheon at the Blue Parrot the group adjourned to the Capitol Life Building where the following program was presented:

Delegate's Report of the St. Louis Meeting—Dr. A. E. Mallory, Colorado State College of Education.

"Aids to Better Teaching"—H. W. Charlesworth, East High School, Denver.

"Mathematics in Action"—Prof. Charles A. Hutchinson, University of Colorado.

Film—"East High School Goes to the Mathematics Exhibit."

The following is a brief summary of Mr. Charlesworth's talk:

Fundamental Assumption: There is no substitute for good teaching. Whatever the ailments are, most of them can be remedied by good teaching.

Given a good teacher, a possible, although perhaps, a meager situation in which to work, we need not worry much about subject values or pupil welfare.

We must not forget that the school exists for the child, not for the teachers or administrators.

We shall assume that the teacher now on the job has been well trained in mathematics, and of course, in general teacher training. We shall assume that this teacher secured his or her job because of this professional training and because of personal qualities and fitness. In addition, we shall accept without proof the fact, that this teacher can and has the desire to improve while in service. Mr. Charlesworth divided his "aids" into two groups as follows:

General Aids

1. Retain enthusiasm for work, teach inspiringly.
2. Support worthwhile national and local mathematical organizations.
3. Teach for understanding and retention.
4. Be open-minded about criticisms and values.
5. Don't hesitate to make changes in methods of teaching.
6. Check your teaching against criteria set up by successful teachers.
7. Teach pupils how to study. Teach the habit of industry.
8. Create attitude of fairness, kindness, friendliness.
9. Read widely, not only in the field of mathematics, but other fields.
10. Teach mathematics as a system of thought, not merely a tool subject.
11. Round out a good philosophy of teaching.

Specific Aids

1. Plan carefully the work of every class period.
2. Teach outside of the text.
3. Allow the pupil to see the "common sense" of mathematics.
4. 4. Use the language and terminology of mathematics.
5. Emphasize constantly the use and value of the check.
6. Stress applications.
7. Talk little during recitations, let pupil have an active part in it.
8. Don't wear out pupils by going over problems already mastered.
9. Have tolerance for other subjects.
10. Give praise where praise is due. Be kind and constructive in criticism.
11. Learn from pupils.
12. Test frequently and comprehensively.
13. Do not use sarcasm.
14. Make frequent and varied reviews of fundamental principles.
15. Make use of pupils' interests in the applications, history, etc.
16. Re-teach arithmetic processes needed.
17. Conserve on class time; be efficient in routine matters.
18. Teach approximate numbers and their computation.
19. Make use of inventory and prognosis tests.
20. Use mathematics as a means for character building.
21. Avoid being too individual.
22. Have a classroom library and use it.
23. Sponsor a mathematics club.
24. Put on a mathematics exhibit and make use of its many helps.

The Women's Mathematics Club of Chicago and vicinity held its second meeting of the year following luncheon at Jacque's Restaurant, 900 North Michigan Avenue, on November 2, 1940.

Mr. C. E. Fawcett of the Ford Motor Company talked on "Mathematics in Industry."

Miss Bonnie Badger, Senn High School, Miss Lillian Arends, Proviso High School; Miss Lennie Turnham, Calumet High School; and Miss Betty Aldeston of Hammond, Indiana were hostesses at the meeting.

LEONORE H. KING, Publicity Chairman

Professor R. G. Sanger of the Mathematics department of the University of Chicago spoke on the topic "Modern Trends in Examinations in Mathematics" at the first meeting of the Men's Mathematics Club of Chicago on October 18, 1940.

The Mathematics Section of the Southeast Division of the Iowa State Teachers Association met in Davenport, Iowa October 11. Miss Marie O. Rearick of the Davenport Senior High School faculty was elected chairman to serve for the next two years. The following was the Section program:

Chairman, Miss LaRue Sowers, Ottumwa.

Address, "The Relation of the National Crisis to Secondary Mathematics," Dr. H. Van Engen, Head Mathematics Department, I.S.T.C.

Address, "The Cooperative Study of Evaluation of Secondary Schools with Reference to Mathematics," Miss Rose Miller, Ottumwa.

LARUE SOWERS, Ottumwa, Iowa

A meeting of the North East District of the Oklahoma Education Association, was held in Miami, Oklahoma, on October 25th, 1940. Chairman: Paul Turner, Nowata; Secretary: Faith Way, Muskogee.

During the business session, new officers elected were: Chairman: Raymond Scott, Tahlequah; Vice-chairman: Dick Woods, Tahlequah; Secretary: Grace West, Tulsa.

Mr. Dees, Barnsdall, gave the only talk, which was, "Mathematics Teachers Accept the Challenge."

Paula Henza, Eastern High School, Detroit, Michigan writes when renewing her subscription to THE MATHEMATICS TEACHER "Dr. Hutchins' article in the last issue was worth a year's subscription and more."

The Autumn meeting of the Connecticut Valley Section of the Association of Teachers of Mathematics in New England was held on Saturday, November 2, 1940 at Mount Holyoke College in South Hadley, Mass.

PROGRAM

Morning Session

10:30—"Finite Fields," Professor Bailey Brown, Amherst College.

11:30—"Some Phases of Industrial Training," Dr. F. E. Searle, Training School of the Ford Motor Car Company.

12:30—Luncheon at the College Inn.

Afternoon Session

1:45—Business Meeting.

2:00—"Statistical Fluctuations and Their Significance," Professor Norbert Wiener, Massachusetts Institute of Technology.

3:00—"Mathematics for the Millions," Dr. Rolland R. Smith, Classical High School, Springfield, Massachusetts.

Officers of the Connecticut Valley Section: Marie Litzinger, President, Mount Holyoke College; William G. Shute, Vice-President, The Choate School; Maytscherl Walsh, Secretary, Bulkeley High School, Hartford; Ethelyn M. Percival, Treasurer, Westfield High School; Leland W. Smith, Director, Classical High School, Springfield; A. E. Andersen, Director, Massachusetts State College.

Past Presidents: Harry B. Marsh, '20; Percy F. Smith, '21; M. M. S. Moriarty, '22; Eleanor C. Doak, '23; Joe G. Estill, '24; Joshua I. Tracey, '25; *Lyon L. Norton, '26; *John W. Young, '27; Rolland R. Smith, '28; Harriet R. Cobb, '29; Melvin J. Cook, '30; Bancroft H. Brown, '31; Dorothy S. Wheeler, '32; H. W. Dadourian, '33; David D. Leib, '34; Nelson A. Jackson, '35; Frederick Mockler, '36; William Fitch Cheney, Jr., '37; Sarah K. Everts, '38; Leland W. Smith, '39.

*Deceased

Mathematics Teachers Again Hold Excellent Meeting

The Southern Section of the Association of Mathematics Teachers of New Jersey met at State Teachers College, Glassboro, New Jersey, Tuesday, October 16, 1940. The topic for discussion was "Adventuring in Geometry."

At four forty-five two demonstration classes were conducted: one for Junior High School, the other for Senior High School. Both classes were from Glassboro Public Schools.

The Senior High School class was conducted by Dr. C. N. Stokes of Temple University. He showed how a beginning class can weigh statements and arrive at conclusions. He first used a simple statement from daily life to show how good thinking builds on assumed or known facts. He then took a Geometric statement and by assuming certain Geometric facts built up a proof. The pupils were keenly interested and

responded eagerly to Dr. Stokes' skillful questioning.

Demonstrating with a group of eighth grade pupils, Mr. Paul J. Whiteley of the Cheltenham Junior High School, developed the concept of volume with particular reference to the formula for volume of a rectangular solid. Carefully executed questions directed the pupils' attention to the fundamental differences between the line, plane, and solid concepts, such as the number of dimensions and the use of linear, square, and cubic units in measuring the figures. The constant use of wood block models of various shapes served to correlate the concrete form with the abstract idea. One outstanding illustration was the building of a "hotel." This was done by using small cubes to represent rooms for the first floor. This made one layer, or story, of the hotel. Then a second story was put on and a third anticipated. Familiar signposts in the way of previously learned formulas pointed the direction for discovering a new rule and a new formula.

The demonstration classes were followed by dinner at the College. After dinner visitors were given an opportunity to see an exhibit of work prepared by State College students.

Promptly at seven o'clock, the evening session was called. Dr. C. N. Stokes of Temple University made a short address. Dr. Stokes said in part that we as teachers are responsible for disciplining the whole individual so that he can think through his problems. Our purpose is not to produce a specialist but to give him powers of understanding and to help him gain a philosophy of life. This type of training means control of economics, social, political powers; produces a thinking individual, one who makes judgments for himself.

The speaker said that with a beginning class in Demonstrative Geometry he would spend until Thanksgiving with the developing of a purpose for studying Geometry. He would develop with them the idea of what good thinking is. First get an impression of the whole problem —that is of the thing we want to prove. This may at first be vague, because it is large. Then the total concept is broken up. The pupil differentiates and after that puts together. In Geometry the pupil picks out the things he has been given to work with, and makes the necessary assumptions. He puts these together and has his proof. Thus develops a way of thinking.

The committee in charge of the meeting was: —Miss Marion Lukens, Camden High School, Chairman; Miss Kjersten Nielsen, State Teachers College, Glassboro; and Mr. Chester A. Olinger, Junior High School, Collingswood.

The Association of Mathematics Teachers of New Jersey held its seventieth regular meeting at Atlantic City on November 9th, 1940, president Mary C. Rogers, of Westfield presiding. The following program was given:

Address—"The Place of Mathematics in Education For Social Change," Dr. Ernst R. Breslich, Department of Education, University of Chicago.

New Jersey's Response:

1. "Number—the Basic Language for Expressing Quantitative Relations," Miss Anne Graffam, Vice-president New Jersey Elementary Mathematics Association.

2. "Mathematics Which Functions in the Expanding Social Life of the Early Adolescent," Chester A. Olinger, Junior High School, Collingswood.

3. "Socio-Economic Mathematics for Senior High School Students," Chauncey W. Oakley, Senior High School, Manasquan.

4. "Mathematics and Technology," Dr. Edward Baker, Newark College of Engineering.

The Mathematics Section of the Wisconsin Education Association was held in Milwaukee at the Hotel Pfister on Thursday November 7th 1940.

The following program was rendered:

1. Discussion Luncheon led by hosts at tables 12:00 noon to 1:45.

Table *Topic and Leader*

1—"Mathematics for Citizenship," Ethelwynn R. Beckwith, Milwaukee-Downer.

2—"Homogeneous Grouping in Mathematics Classes," R. O. Christoffersen, Madison.

3—"Let's Discuss Our Troubles," Ethel Daley, DePere.

4—"The Significance of Mathematics for College Preparatory Pupils," H. P. Evans, University of Wisconsin.

5—"The Pre-engineering Student," Louise Fromm, Two Rivers.

6—"Teaching Materials in Mathematics." Alice Gruenberger, Plymouth.

7—"Geometry: A Weapon for Defense," Mary E. Henry, Milwaukee.

8—"Techniques in Individualized Instruction," Oscar Melby, Madison Vocational School

9—"Factors Influencing the Child's Success in Problem Solving," Elda Merton, Waukesha.

10—"Mathematics with Immediate Practical Implications for All Pupils," Vernon Ramberg, Lake Geneva.

11—"Historical and Other Reference Materials as Teaching Aids," J. H. Rose, Whitefish Bay.

12—"Open to Those Interested in Activities of

the National Council of Teachers of Mathematics in Wisconsin," Elmer G. Schuld, Wisconsin High School.

13—"Mathematics Clubs," Victor Schumann, Portage.

14—"Implications of the Study of Arithmetic to Social Problems," A. J. Smith, Union Grove.

15—"Thinking of the Accelerated Student," Margaret Striegl, Milwaukee.

16—"They Can't Read—So What?" Orpha Thompson, Beloit.

17—"Leading Trends in the Teaching of Geometry," L. S. Turner, Shorewood.

18—"The Locus Concept in Plane Geometry," Paul W. Waterman, Milwaukee Country Day School.

19—"Making and Using Models," Theodore C. Potter, Milwaukee.

2. Address 2:00 P.M. "We Mathematically Trained Citizens."—Professor Mark H. Ingraham, University of Wisconsin.

3. Brief business meeting.

4. Address: "Mathematics for All Laymen" —Professor Harold Fawcett, University High School, Columbus Ohio.

Professor John C. Penn, of Armour Institute of Technology, spoke on "Navigation" at the May meeting of the Men's Mathematics Club of Chicago and the Metropolitan Area. Professor Penn discussed the progress of navigation as indicated by the tools used, the mechanical devices used to solve spherical triangles, latitude determinations, azimuth determinations, time, and longitude.

Dr. Max Black, recently on the staff of the University of London Institute of Education, has joined the faculty of the University of Illinois.

The rank of tutor was accorded Dr. Black at the University of London. This rank is equivalent to professorial rank in American universities. He received his doctor of philosophy degree from the University of London and has served on its faculty since 1936.

Many American teachers of mathematics know Dr. Black because he has taught in the summer session of Teachers College, Columbia University.

Professor G. D. Birkhoff of Harvard University has been elected Foreign Associate of the National Academy of Sciences of Lima.

The New Jersey State Secondary School Conference held at New Brunswick, May 3 and 4, included a session of the Association of Mathematics Teachers of New Jersey.

"Meeting the Challenge of Youth" was the theme of a panel discussion on May 4. The members of the panel and their topics were: Dr. Frank J. McMackin, Jersey City, "Meeting the Challenge of Youth by Clearly Defining the Place of Mathematics in the High School Curriculum"; Miss Lora D. Jahn, Trenton, "Meeting the Challenge of Youth from the Point of View of the Curriculum of the Junior High School"; Harold A. Zantow, Hoboken, "Meeting the Challenge of Youth through the Development of a Guidance Attitude in the Mathematics Classroom"; Dr. E. H. C. Hildebrandt, Montclair, "Meeting the Challenge of Youth through Extra-Classroom Activities"; and Jerome Schlosser, Newark, "Meeting the Challenge of Youth through Mathematics Clubs, Programs, Bulletins, and Procedures."

The Cleveland Mathematics Club held its twentieth anniversary dinner on March 8. President Ona Kraft started the after-dinner program. D. W. Werremeyer, first president of the club, followed with reminiscences. Mrs. Florence Brooks Miller, also a past-president, spoke on "Twenty Years in Review." Charles H. Lake, T. M. Focke, Webster G. Simon, and M. E. Tolar followed with short talks. The past-presidents in attendance were introduced.

William Betz, Specialist in Mathematics in the Rochester, N. Y., school system, was the principal speaker of the evening and took for his topic "Twenty Years of Service by the Cleveland Mathematics Club."

Professor W. D. Reeve, of Teachers College, Columbia University, addressed the Nassau County Mathematics Teachers' Association on April 18. His topic was "The Problem of the Bright and the Dull Normal Child."

Other speakers of the past school year were Dr. R. R. Smith, supervisor of mathematics in Springfield, Mass., on "Teaching Mathematics for Meaning"; Ralph McLeary, supervisor of mathematics in Brookline, Mass., on "Trends in Plane Geometry and Plane Geometry Textbooks"; and Dr. Fred Bedford, co-author with Dr. C. N. Shuster of *Field Work in Mathematics*. Dr. Bedford spoke on "The Use of Instruments in Teaching Mathematics."

The Nassau County Mathematics Teachers Association is making an investigation of mathematics textbooks. A committee is compiling a list of textbooks found most satisfactory by teachers.

The William Lowell Putnam Scholarship for study at Harvard University has been awarded for 1940 to Andrew M. Gleason of Yale University, Class of 1942.

Sixty-five mathematics teachers of the Maryland State Teachers Association took their spring meeting to Washington, D.C., on May 18. Their itinerary was:

8:55 A.M.—Left from Mt. Royal Station.

9:40 A.M.—Arrived Union Station—Washington, D. C. Motor buses waiting at far left end of Union Station for transfer to the Folger Library. Walked over to the Supreme Court Building opposite the Library where buses were parked awaiting our arrival.

10:45 A.M.—Left for Bureau of Standards Building.

12:45 P.M.—Left for Dodge Hotel for luncheon.

1:00 P.M.—Luncheon speaker: Dr. Oscar Blackwelder—Topic: Americanism—Giving and Taking.

2:30 P.M.—Left hotel in buses for the Monastery and Catacombs.

5:00 P.M.—Left Union Station via Baltimore and Ohio Railroad.

5:51 P.M.—Arrived Mt. Royal Station—Baltimore.

Even though these teachers got away from home and mathematics the meeting was a huge success.

Professor Julian L. Coolidge was awarded the honorary degree of LL.D. by Harvard University at Commencement, 1940.

The following people have reported speaking engagements during the current year.

1. F. L. Wren, at Illinois High School Conference, Mathematics Section, Urbana, Illinois, Friday, November 1. Topic: "The Role of Relational Thinking in the Teaching of Mathematics."
2. H. C. Christofferson in Buffalo, New York, October 25.
3. Vera Sanford at Tri-County Teachers' meeting at Oneonta, New York, September 20.
4. Virgil S. Mallory at Syracuse, New York, on July 19. Topic: "Transcription of a Demonstration lesson in 10th Grade Geometry—Postulational Thinking."
5. William Betz at the Mathematics Section of Maryland State Teachers Association on Friday afternoon, October 25, at 3:15. There is to be a dinner followed by an informal social gathering.
6. Raleigh Schorling, School of Education, Ann Arbor, Michigan, at Evansville, Indiana, on October 24.

Miss Etta Greenberg of Washington Irving High School was elected president of the Association of Teachers of Mathematics in New York City at its last meeting. Other officers named were: Vice-president for high schools, Jack G. Deutsch, Thomas Jefferson High School; vice-president for junior high schools, Miss Lorraine Addleston, Junior High School 159; secretary, Miss Ida A. Sussman, Junior High School 81; treasurer, Max Peters, Lafayette High School.

Members named to the executive board were: Samuel Altwerger, High School of Science; Miss Grace Carlin, Junior High School 128, Brooklyn; David Gordon, New Utrecht High School; Julius H. Hlavaty, High School of Science; Miss Henriette Midonick, De Witt Clinton High School; George Ross, Erasmus Hall High School; Aaron Shapiro, Alexander Hamilton High School; Miss Catherine Wilson, Christopher Columbus High School.

The spring meeting of the Mathematic Section of the California Teachers Association, Bay Section, was held at International House in Berkeley, Saturday, April 20, with Mrs. Ruth G. Sumner, chairman, presiding. The section had as guests Professor Frank N. Freeman, the new Dean of the School of Education, and Mrs. Freeman, known to teachers of mathematics as Mrs. Flora Miller Dunn.

The guest speaker was Professor Eric Temple Bell of the California Institute of Technology, who chose as his subject, "Seven Thousand Years of Mathematics." He pointed out the contributions of each of three eras, 5700 B.C. to 1637 A.D., 1637 to 1801, and 1801 to the present, showing how they have led to the Golden Age of Mathematics, the last hundred years. His address was a stimulating appeal to teachers of mathematics to appreciate the spirit of modern mathematics and to teach it.

The section voted unanimously to adopt a resolution similar to those adopted by the Northern California Section of the Mathematical Association of America at its annual meeting in Berkeley January 27, by the Southern California Section of the Mathematical Association of America at its meeting in Compton on March 2, and by the American Mathematical Society at its meeting on April 6, as follows:

> "The Mathematics Section of the California Teachers Association, Bay Section, and those in attendance at the meeting of the section wish to go on record as favoring that a program of mathematics be provided in the secondary schools, beginning normally with algebra in the ninth year, to be available to

those who wish to elect it or who otherwise need it in preparation for college work. It is felt that a capable student should be able to secure solid geometry and trigonometry in the secondary school."

This resolution in no way implies that college preparatory courses should be required of all students. But these four organizations feel strongly the importance of continuing to provide substantial courses in mathematics for those who need them in preparation for later work or for those who choose to elect them. We believe that, to be effective, these courses must begin with algebra in the ninth year.

The election of officers for the coming year resulted as follows: Advisory Chairman: Alvin C. Barker, Lowell High School, San Francisco; West Bay Chairman: Mrs. Maud Oakes Volandri, Balboa High School, San Francisco; West Bay Secretary: Norma Klaus, Balboa High School, San Francisco; East Bay Chairman: Mary Banning, Elmhurst Junior High School Oakland; East Bay Secretary: C. S. Cramer, McKinley Continuation High School, Berkeley.

EMMA HESSE
California Representative

The Wichita Mathematics Association met April 25, 1940, at Wichita High School East. The meeting opened with a short business session and the election of officers. Our officers for next year are: President, Lorena E. Cassidy, Wichita High School East; Vice President, Clara Peterson, Roosevelt Intermediate; Program Chairman, Dr. C. B. Read, University of Wichita; Treasurer, Nelle Leichhardt, Horace Mann Intermediate; Secretary, Pearl Miltner, Hamilton Intermediate.

After the business meeting, we enjoyed a program of talent given by some of our members. This program was in charge of Lucy Hall of Wichita High School North.

As a part of the program, Mrs. M. Bird Weimar made some remarks as a tribute to Mary Kelly, who retired last spring, for her outstanding success as a teacher of mathematics. She also expressed the appreciation of this group for Miss Kelly's leadership in our association.

Those present then enjoyed the sociability of a tea especially honoring Miss Kelly, Arthur J. Hoare, and Ruth Woodworth. Mr. Hoare and Miss Woodworth have served respectively as president and secretary of the Wichita Association since it was organized.

PEARL MILTNER
Secretary

The Portland Council of Teachers of Mathematics had an excellent meeting at Reed College, Portland, May 4.

The general subject was "Interesting Applications of Mathematics." Graphs, models, and instruments constructed by students were shown. About seventy teachers were present.

The Portland Council has been made statewide. Additional vice-presidents from other sections of the state elected were as follows: Willamette Valley, Kenneth L. Kienzle, Eugene High School, Eugene; Southern Oregon, Ted Russell, Klamath Union High School, Klamath Falls; Eastern Oregon, Harold W. King, La Grande High School, La Grande.

EDGAR E. DECOU
Oregon Representative

The final meeting of the Women's Mathematics Club of Chicago and Vicinity for the year 1939–1940 was held at the Kentucky-Serves-a-Dinner on the near north side of the city, May 11.

The following officers were elected for the year 1940–1941: Clara Haertel, President; Mary Jane Hartman, Vice-president; Mildred Taylor, Secretary; Lucy Hainbecker, Treasurer; Mrs. Dorothy Littleton, Program Chairman.

The speaker of the day was R. L. Short, Principal of the Ashland School, St. Louis, Missouri. He gave a very interesting talk on "Mathematical Short Cuts."

DOROTHY B. LANDERS

The last meeting of the Suffolk County Mathematics Teachers Association was held at "The Milestone," Sayville, L. I., May 8, 1940. Twenty-three members and guests were present to enjoy a most delicious turkey dinner. After the dinner there was a short business meeting at which the present officers were re-elected as follows: President, Robert Folsom, Huntington; vice-president, Mrs. Harriet J. Burgie, Sayville; secretary-treasurer, Elizabeth Ormsby, Bayport.

Our guest speaker was Dr. Rolland R. Smith, specialist in mathematics for the public schools of Springfield, Mass. He spoke on the topic "Meaningful Mathematics." A great deal of interest and enthusiasm was shown and everyone agreed that this very worth-while talk of Dr. Smith's was a most successful ending for our year's meetings.

ELIZABETH ORMSBY
Secretary

The Nebraska Section of the National Council of Mathematics Teachers met with the science teachers of the state for its annual con-

ference, at Chadron, May 11, 1940. Miss Eva Phalen of Kearney, president, had charge of the following program:

"Functional Mathematics and Functional Figures," Prof. C. A. Hutchinson, Univ. of Colorado, Boulder, Colo.

"A Report of the St. Louis Convention," Dr. A. R. Congdon, University of Nebraska.

At the 12:30 luncheon, a motion picture "Parabola," by Rutherford Boyd, painter, illustrator, lecturer, and writer was shown.

The following officers for 1940–41 were elected: President, Milton Beckman, Kearney; Vice-president, Lena Meyer, Kimball; Secretary, Leo Taylor, Norfolk; Treasurer, Ruth Thompson, Minden.

Other members of the board are: Ruth Muir, York; Henrietta Raney, Columbus.

LEO TAYLOR
Secretary

The Fifteenth Annual Conference of Teachers of Mathematics was held in Iowa City on October 11 and 12, 1940. The following program was given:

FRIDAY MORNING, OCTOBER 11, 1940
North Room, Old Capitol
H. L. RIETZ, *presiding*

10.00 A.M. Address: Creative Imagination through High School Mathematics. Gertrude Hendrix, Eastern Illinois State Teachers College, Charleston.

10.30 A.M. Address: Developing Understanding in Junior High School Mathematics. Katherine Young, Wallace Junior High School, Waterloo.

11.00 A.M. Address: The Definite Integral. Lewis E. Ward, University of Iowa. Discussion.

FRIDAY AFTERNOON, OCTOBER 11, 1940
North Room, Old Capitol
E. N. OBERG, *presiding*

1.30 P.M. Address: The Arithmetical Responsibility of the Secondary School, F. L. Wren, George Peabody Teachers College, Nashville.

2.00 P.M. Address: The Mathematics Needed for Certain Scientific Courses. George H. Nickle, Keokuk High School, Keokuk.

2.30 P.M. Address: Curriculum Trends and the Implications for High School Mathematics. George B. Smith, University of Iowa. Discussion.

FRIDAY EVENING, OCTOBER 11, 1940
Iowa Memorial Union
River Room

6.00 P.M. Conference Dinner. Ruth Lane, *Presiding.*
Play: A question of Figures.
University High School Pupils.

SATURDAY MORNING, OCTOBER 12, 1940
North Room, Old Capitol
L. A. KNOWLER, *presiding*

9.30 A.M. Address: The Concept of Freedom through High School Mathematics, Gertrude Hendrix.

10.00 A.M. Address: The Place of Mathematics in a Functional Curriculum. F. L. Wren. Discussion.

President Potter has recently appointed the following persons to act as a Dictionary Committee for the National Council of Teachers of Mathematics: J. O. Hassler, Chairman; E. R. Breslich, Virgil S. Mallory, Vera Sanford, and Raleigh Schorling.

These people are to act as experts in assisting in the compilation of a dictionary of Education, sponsored by Phi Delta Kappa, an honorary education fraternity.

The Women's Mathematics Club of Chicago and Vicinity held its first meeting of this school year on October 5, at Eckhardt Hall, University of Chicago, where Dr. Ernest P. Lane lectured on "Mathematical Models."

Newly elected officers of the club include Miss Clara Haertel, President, Miss Mildred Taylor, Secretary, Miss Lucy Hainbecker, Treasurer, Mrs. Dorothy Littleton, Program chairman, Miss Dorothy Landers, Hospitality chairman and Miss Lenore King, Publicity chairman, all of Chicago and Vice president, Miss Mary Jane Hartman, of Oak Park, and Membership Chairman, Miss Mabel Swanson of Maywood.

LENORE KING
Publicity Chairman

◆ NEW BOOKS RECEIVED ◆

Plane Geometry and Its Reasoning. By H. C. Aarber and G. Hendrix. x+310 pp. 1937. Harcourt, Brace and Company, Inc., New York. Price $1.40.

Trigonometry. By J. W. Branson and J. O. Hassler. viii+73 pp. 1937. Henry Holt and Company, 257 Fourth Avenue, New York. Price without tables $1.50; tables separately 45 cents; entire book $1.75.

A First Year of College Mathematics. By R. W. Brink. pp xvi+667. 1937. D. Appleton-Century Company, New York. Price $3.50.

Intermediate Algebra. By W. E. Brooke and H. B. Wilcox. viii+323 pp. 1938. Farrar and Rinehart Company, New York. Price $1.90.

The Calculus. Revised edition. By R. D. Carmichael, J. H. Weaver, and L. Lapaz. xvi +384 pp. 1937. Ginn and Company, 15 Ashburton Place, Boston, Mass. Price $3.00.

Modern School Arithmetic. By J. R. Clark, A. S. Otis, C. Hatton, and R. Schorling. Grades Seven and Eight. Seventh Grade, Eighth Grade, xii+308 pp. 1938. World Book Company, Yonkers-on-Hudson, N. Y.

Our Physical World. By C. F. Eckels, C. B. Shaver, and B. W. Howard. xi+801. 1938. Benj. H. Sanborn and Company, Boston. Price $2.20.

Computation and Trigonometry. By H. J. Gay. vii+231 pp. 1938. The Macmillan Company, New York. Price $1.90 (with tables, $2.40).

The New Trend Arithmetic. New York State Edition. By H. O. Gillet, T. J. and F. Durell, and B. A. Sueltz. Third Year, xii+306 pp. Fourth Year, xiii+306 pp. Fifth Year, xiv +304 pp. Sixth Year, xv+335 pp. 1938. Charles E. Merrill Company, New York. Price: 3d and 4th, $.72; 5th and 6th, $.76 each.

Analytic Geometry. By P. H. Graham, H. W. John, and H. R. Cooley. xx+294 pp. 1936. Prentice-Hall, Inc., 70 Fifth Avenue, New York. Price, $2.35.

Plane Trigonometry. By A. M. Harding and G. W. Mullins. vii+172 pp. 1937. The Macmillan Company, New York. Price, $1.60. (with tables $2.10)

A Short Course in Trigonometry. By J. G. Hardy. Revised Edition. ix+143 pp. 1938. The Macmillan Company, New York. Price, $2.25.

A College Algebra. By W. L. Hart. Revised Edition. viii+408+30 pp. 1938. D. C. Heath and Company, New York. Price, $2.24.

Progressive Solid Geometry. By W. W. Hart. ix +596 pp. 1936. D. C. Heath and Company, New York. Price, $1.36.

Elementary Mathematical Analysis. By Theodore Herberg. v+120 pp. 1937. D. C. Heath and Company, New York. Price, $1.24.

Introduction to College Mathematics. By M. A. Hill and J. B. Linker. xii+373+93 pp. 1938. Henry Holt and Company, 257 Fourth Ave., New York. Price, $2.40.

Principles of Accounting. By G. R. Husband and O. Thomas. x+801 pp. 1935. Houghton Mifflin and Company, New York. Price, $4.00.

Elementary College Algebra. By H. W. Kuhn and J. H. Weaver. xvi+359 pp. 1935. The Macmillan Company, New York. Price, $2.00.

The Calculus. By H. W. March and H. C. Wolff. xvii+424 pp. 1937. McGraw-Hill Book Company, Inc., New York. Price, $1.50.

Plane Trigonometry. By W. K. Morrill. ix+167 pp. 1938. Farrar and Rinehart, Inc., New York. Price, $1.60.

Analytic Geometry and Calculus. By Max Morris and Orley E. Brown. x+507 pp. 1937. McGraw-Hill Book Company, Inc., New York. Price, $2.50. Second Edition.

College Algebra. By. C. I. Palmer and W. L. Miser. xvi+467 pp. 1937. McGraw-Hill Book Company, Inc., New York. Price, $2.50.

Plane Trigonometry. By K. B. Patterson and A. O. Hickson. ix+219 pp. 1936. F. S. Crofts and Company, New York. Price, $2.50. Second Edition.

The World Around Us. By S. R. Powers, E. F. Neuner, and H. B. Bruner. xviii+477 pp. 1934. Ginn and Company, 15 Ashburton Pl., Boston, Mass. Price, $1.20.

This Changing World. By S. R. Powers, E. F. Neuner, and H. B. Bruner. xiv+561 pp. 1934. Ginn and Co., 15 Ashburton Pl., Boston, Mass. Price, $1.40.

Man's Control of His Environment. By S. R. Powers, E. F. Neuner, and H. B. Bruner. xiv+753+32. pp. 1935. Ginn and Co. Price, $1.60.

Plane and Spherical Trigonometry. By J. B. Rosenbach, E. A. Whitman, and David Moskovitz. x+336+xxvii pp. 1937. Ginn and Co. Price, $2.00.

Essentials of the Mathematics of Investment. By P. R. Rider. x+162 pp. 1938. Farrar and Rinehart, Inc., New York. Price, $2.00.

The Mathematics of Finance. By T. M. Simpson, Z. Pirenian, and B. H. Crenshaw. Second Edition. xiii+330 pp. 1936. Prentice-Hall, Inc., New York. Price, $3.50. (with tables, $3.75)

Freshman Mathematics. By H. L. Slobin and W. E. Wilbur. Revised Edition. xviii+438 pp. 1932. Ray Long and R. R. Smith, Inc., New York. Price, $3.50.

New Analytic Geometry. By P. F. Smith, A. S. Gale, and J. H. Neelley. Alternate Edition. x+336 pp. 1938. Ginn and Co., Boston. Price, $2.00.

Modern Bookkeeping. By W. L. Starkey. vii+242+4 pp. 1936. Globe Book Co., New York. Price, $1.00. (paper, $.67)

Duodecimal Arithmetic. By G. S. Terry. 299 pp. 1938. Longmans, Green and Co. 114 5th Ave., N. Y. Price, $7.50.

Modern School Geometry. By R. Schorling, J. R. Clark, and R. R. Smith. xiv+450 pp. 1938. World Book Co.

Intermediate Algebra By S. E. Urner and W. B. Orange. xv+432 pp. 1937. Mc. Graw-Hill Book Co. Price, $2.00.

Mathematics in Daily Life. By Eugene H. Barker and Frank M. Morgan. vi+437 pp. 1939. Houghton Mifflin Company, Cambridge, Mass. Price, $1.32.

Coordinate Solid Geometry. By Robert J. T. Bell. xiii+218 pp. 1938. Macmillan and Co., Ltd., London. Price $2.25 (from The Macmillan Company, New York).

The Concepts of the Calculus. By Carl B. Boyer. vii+346 pp. 1939. Columbia University Press, New York. Price, $3.75.

Algebra an Interesting Language. By Ernst R. Breslich. viii+70 pp. 1939. The Orthovis Company, Chicago. Price, $1.20.

Excursion in Mathematics. By Ernst R. Breslich. viii+47 pp. 1938. The Orthovis Company, Chicago. Price $1.50.

Essentials of Analytic Geometry. By Raymond W. Brink. xi+233 pp. 1939. D. Appleton-Century Co., Inc., New York. Price, $2.25.

Coordinate Geometry. By Luther P. Eisenhart. xi+298 pp. 1939. Ginn and Company, Boston. Price, $2.50.

Elementary Mathematics from an Advanced Standpoint, Geometry, Part I. By Felix Klein. Translated by E. R. Hedrick and C. A. Noble. ix+214 pp. 1939. The Macmillan Company, New York. Price, $3.00.

Understanding Our Environment. By John C. Hessler and H. C. Shoudy. ix+661 pp. 1939. Benj. H. Sanborn and Co., Chicago and Boston. Price, $1.80.

Mathematical Clubs and Recreations. By Samuel I. Jones. xiv+236 pp. 1940. S. I. Jones Co., Nashville, Tenn. Price, $2.75.

Mathematics of Statistics. Part One. By Joseph F. Kenney. x+248 pp. 1939. D. Van Nostrand Company, Inc., New York. Price, $4.00.

New Practical Mathematics. By N. J. Lennes. ix+426 pp. 1939. The Macmillan Company, New York. Price, $1.32.

Analytic Geometry. By Clyde E. Love. xiv+297 pp. 1938. The Macmillan Company, New York. Price, $2.75.

Plane Geometry. By George T. Major. xv+280 pp. 1938. Charles Scribner's Sons, New York. Price, $1.20.

Differential and Integral Calculus. By John H. Neelley and J. I. Tracey. ix+495 pp. 1939. The Macmillan Company, New York. Price, $3.25.

Elements of the Topology of Plane Sets of Points. By M. H. A. Newman. viii+221 pp. 1939. Cambridge University Press, New York. Price, 12s. 6d. (Macmillan $3.50)

Psychology and Teaching of Secondary-School Subjects. By Homer B. Reed. xviii+684 pp. 1939. Prentice-Hall, Inc., New York. Price, $3.25.

College Algebra. By Paul K. Rees and Fred W. Sparks. xi+312 pp. 1939. McGraw-Hill Book Company, Inc., New York. Price, $2.25.

College Algebra. By H. L. Rietz and A. R. Crathorne. xvi+298 pp. 1939. Henry Holt and Company, New York. Price, $1.85.

College Algebra. By Joseph B. Rosenbach and Edwin A. Whitman. x+470 pp. 1939. Ginn and Company, Boston. Price, $2.25.

Synthetic Projective Geometry. By R. G. Sanger. ix+175 pp. 1939. McGraw-Hill Book Company, Inc., New York. Price, $2.00.

Business Arithmetic for College Students. By William S. Schlauch. vii+299 pp. 1939. F. S. Crofts and Co., New York. Price, $2.80.

An Introduction to Modern Geometry. By Levi S. Shively. xi+167 pp. 1939. John Wiley and Sons, Inc., New York. Price, $2.00.

Fabre and Mathematics and Other Essays. By Lao Genevra Simons. v+101. 1939 pp. Scripta Mathematica, Yeshiva College, New York. Price, $1.00.

Basic Principles of Analytic Geometry. By Walter A. Spencer. iv+27 pp. 1939. The Orthovis Company, Chicago. Price, $2.20.

Plane Trigonometry. By W. T. Stratton and R. D. Daugherty. vii+118 pp. 1939. Prentice-Hall, Inc., New York. Price, $2.25.

Laboratory Manual and Problems for Elements of Statistical Method. By Albert E. Waugh.

x+171 pp. 1938. McGraw-Hill Book Company, Inc., New York. Price, $1.50.

Introduction to the Theory of Equations. By Louis Weisner. ix+188 pp. 1938. The Macmillan Company, New York. Price, $2.25.

The Transits of Mercury. By Kenneth P. Williams. 70 pp. 1939. Indiana University, Bloomington, Ind. Price, $0.50.

Teaching the New Arithmetic. By Guy M. Wilson, Mildred B. Stone, and Charles O. Dalrymple. xi+458 pp. 1939. McGraw-Hill Book Company, Inc., New York. Price, $3.00.

Practical Shop Mathematics, Vols. I and II. By John H. Wolfe and Everett R. Phelps. Vol. I, xiv+349 pp.; Vol. II, xiv+318 pp. McGraw-Hill Book Company, Inc., New York. Price, $2.20 each vol.

Analytic Geometry. By Roscoe Woods. xiii+294 pp. 1939. The Macmillan Company, New York. Price, $2.25.

Analytic Geometry and Calculus. By Frederick S. Woods and Frederick H. Bailey. xi+524 pp. 1938. Ginn and Company, Boston. Price, $4.00.

Outline of the History of Mathematics. By Raymond Clare Archibald. 66 pp. 1939. The Mathematical Association of America, Inc., Oberlin, Ohio. Price, $0.50.

Learning Activities in Elementary Algebra. By Earl J. Burnett and Regina Grosswege. iv+228 pp. 1939. College Entrance Book Co., Inc., New York. Price, $0.90.

Learning Activities in Plane Geometry. By Earl J. Burnett and William E. Batzler. viii+248 pp. 1939. College Entrance Book Company, Inc., New York. Price, $0.90.

New Tests and Drills in First Course in Algebra. By Walter W. Hart. 182 pp. 1938. D. C. Heath and Company, Boston. Price, $0.40.

Rhyme of Reason. By Roger W. Holmes. xiv+516. 1939. D. Appleton-Century Co., Inc., New York. Price, $3.75.

Teaching Mathematics in the Secondary Schools. By John H. Minnick. xiv+336 pp. 1939. Prentice-Hall, Inc., New York. Price, $3.00.

Useful Mathematics Workbook. By Mary A. Potter. 112 pp. 1939. Ginn and Company, Boston. Price, $0.48.

Elliptic and Hyperelliptic Integrals and Allied Theory. By W. R. Westropp Roberts. viii+311 pp. 1938. Cambridge University Press, New York. Price, 12s. 6d. (Macmillan $3.75)

A Picture Dictionary for Children. By Garnette Watters and S. A. Courtis. 478 pp. 1939. Grosset and Dunlap, New York. Price, $1.00.

Elementary Statics. By M. Appleby. viii+164 pp. Cambridge University Press. Price, $2.25 (from The Macmillan Company, New York)

Advanced Algebra. By S. Barnard and J. M. Child. x+280 pp. 1939. Macmillan and Company, London. Price, $4.00 (from the Macmillan Company, New York).

Algebra for Today. Second Course, New Edition. By William Betz. xii+518 pp. 1938. Ginn and Company, Boston. Price, $1.36.

The Development of a Course in the Physical Sciences for the Lincoln School. By H. Emmett Brown. ix+205 pp. 1939. Bureau of Publications, Teachers College, Columbia University, New York. Price, $2.25.

Educational Temperatures, Cooperative Study of Secondary School Standards, 744 Jackson Place, Washington, D. C. 62 pp. 1940. Price, $0.50.

Evaluation of Secondary Schools, Cooperative Study of Secondary School Standards, 744 Jackson Place, Washington, D. C. xxx+526 pp. 1939. Price, $3.50.

Evaluative Criteria, Cooperative Study of Secondary School Standards, 744 Jackson Place, Washington, D. C. 176 pp. 1940. Price: cloth, $1.00; paper, $0.60.

How to Evaluate a Secondary School, Cooperative Study of Secondary School Standards, 744 Jackson Place, Washington, D. C. 163 pp. 1940. Price: cloth, $1.25; paper, $0.90.

A Course in General Mathematics. By C. H. Currier, E. E. Watson, and J. S. Frame. ix+382 pp. 1939. The Macmillan Company, New York. Price, $3.00.

Introduction to the Calculus. By Arnold Dresden. xii+428 pp. 1940. Henry Holt and Company, New York. Price, $3.40.

Elementary Algebra. By Aaron Freilich, Henry H. Shanholt, and Joel S. Georges. v+544 pp. 1940. Silver Burdett Company, New York. Price, $1.36.

Suggestions for Teaching Selected Material from the Field of Genetics. Monograph Number One. Bureau of Educational Research in Science, Teachers College, Columbia University, New York. Price, $0.50.

Introductory Business Mathematics. By Joel S. Georges and William H. Conley. x+326 pp. 1940. Henry Holt and Company, New York. Price, $2.40.

A New Geometry. By Theodore Herberg and Joseph B. Orleans. vii+402 pp. 1940. D. C. Heath and Company, Boston. Price, $1.36.

Brief Course in Analytics. By M. A. Hill, Jr. and J. B. Linker. ix+204 pp. 1940. Henry Holt and Company. Price, $1.36.

Applied Mathematics. By James F. Johnson. x+434 pp. 1939. The Bruce Publishing Company, Milwaukee. Price, $1.40.

Mathematical Methods in Engineering. By Theodore V. Karman and Maurice A. Biot. xii+

505 pp. 1940. McGraw-Hill Book Company, Inc., New York. Price $4.00.

Plane Trigonometry. By Miles A. Keasey, G. Alfred Kline, and D. Allison McIlhatten. ix+136 pp. 1939. P. Blakiston's Son and Co., Inc., Philadelphia.

Elementary Theory of Equations. By William Vernon Lovitt. xi+237 pp. 1939. Prentice-Hall, Inc., New York. Price, $2.50.

The Arithmetic of Business. By Frank J. McMackin, John A. Marsh, and Charles E. Baten. ix+486 pp. 1939. Ginn and Company, Boston. Price $1.48.

Elementary College Mathematics. By Ernest L. Mackie and Vinton A. Hoyle. ix+78 pp. 1940. Ginn and Company, Boston. Price, $2.50.

Everyday Arithmetic for Printers. By John E. Mansfield. 135 pp. 1940. McGraw-Hill Book Company, Inc., New York.

Descriptive Geometry. By A. V. Millar and K. G. Shiels. x+192 pp. 1939. D. C. Heath and Company, Boston. Price, $2.25.

Business Mathematics. By Isaiah Leslie Miller and Clarence H. Richardson. xii+352 pp. 1939 (second edition). D. Van Nostrand Company, Inc., New York. Price, $3.75.

An Advanced Course in Algebra. By Norman Miller and Robert E. K. Rourke. xiii+326 pp. 1940. The Macmillan Company of Canada, Ltd., 70 Bond Street, Toronto, 2. Price, $1.25.

Modern Agricultural Mathematics. By Maurice Nadler. x+315 pp. 1940. Orange Judd Publishing Company, Inc., Price, $2.00.

Everyday Problems in Mathematics. By Gilbert D. Nelson, Joseph M. Jacobs, and Fred N. Burroughs. viii+494+viii. 1940. Houghton Mifflin Company, Boston. Price, $1.40.

Practical Mathematics: Part I, Arithmetic with Applications, by Claude Irwin Palmer and Samuel Fletcher Bibb. xii+186 pp. 1940. McGraw-Hill Book Company, Inc., New York. Price, $1.25.

College Algebra. By Lewis M. Reagan, Ellis R. Ott, and Daniel T. Sigley. xviii+445 pp. 1940. Farrar and Rinehart, Inc., New York.

College Algebra. By Paul R. Rider. ix+372 pp. 1940. The Macmillan Company, New York. Price, $2.00.

Calculus. By Charles K. Robbins and Neil Little. viii+398 pp. 1940. The Macmillan Company, New York. Price, $3.25.

An Introduction to Analytical Geometry. By A. Robson. Volume I. xiv+409 pp. 1940. Cambridge University Press. Price, $2.50 (from The Macmillan Company, New York).

Learning to Compute. By Raleigh Schorling, John R. Clark, Mary Potter, and Carroll F. Deady. Book One and Book Two, viii+104 pp. each. 1940. World Book Company, Yonkers-on-Hudson, New York. Price, $0.32 each.

A Short History of Science. By W. T. Sedgwick and H. W. Tyler; revised by H. W. Tyler and R. P. Bigelow. xxi+512 pp. The Macmillan Company, New York.

College Algebra. By Charles H. Sisam. xii+395. 1940. Henry Holt and Company, Inc., New York. Price, $1.90.

Modern-School Solid Geometry. By Rolland R. Smith and John R. Clark. vii+248 pp. 1939. World Book Company, Yonkers-on-Hudson, New York. Price, $1.28.

Mathematics Review Exercises. By David P. Smith, Jr., and Leslie T. Fagan. vii+280 pp. 1940. Ginn and Company, Boston. Price, $1.28.

Advanced Calculus. By Ivan S. Sokolnikoff. x+446 pp. 1939. McGraw-Hill Book Company, Inc., New York. Price, $4.00.

Mathematical Snapshots. By H. Steinhaus. 135 pp. G. E. Stechert and Company, New York. Price, $2.50.

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